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How to Fire the Down-Draft Smokeless Boiler

Important Points to Consider in Obtaining the Required Efficiency with This Type of Heater.

By A. BEMENT.

After preparing the original manuscript for this article the writer had occasion to make a considerable investigation of furnace equipment for apartment house boilers as now made for burning bituminous coal and found that many down-draft boilers are improperly designed. At the time of writing he was aware that this was true of certain makes, but did not realize that it applied to so large a number.

The leader will therefore understand that what follows applies to a properly-designed furnace, and should be of especial value in setting forth the possibilities of the down-draft principle.

The manner in which present design fails is in making it impossible to poke the fire as specified, and in not providing for a sufficient fuel bed on the water grate.

What is generally known as the smokeless boiler in the low-pressure heating service of apartment houses and residences for bituminous coal, is the old Hawley down-draft furnace adapted to a new service. This furnace is what may be called a two-story affair, having two fire grates, one above the other. The upper is composed of pipes which are connected to the boiler, and through which water circulates, so in fact the grate is a part of the boiler. The lower is an ordinary cast-iron grate which may be a shaking grate or not. The fire is on the upper grate and burns downward, so it may be said to burn upside down. Fresh coal is placed on the top of the fuel bed, and the volatile gases which are distilled from it must pass, together with the air for combustion, down through the incandescent portion of the fuel bed, where complete combustion is assured, because the volatile combustible matter and the air are forced together during their passage through the hot zone. This performance is just opposite to that of an ordinary fire, in which the evolved volatile is flowing away from a hot, to a cooler zone, also with which there is no compelling influence to cause contact between and a mixing together of the volatile and the air.

A considerable quantity of live coals fall from between the water bars upon the lower grate, where they are burned. As all the volatile has been distilled from them, they of course do not smoke. The ashes also fall from the upper to the lower grate.

The down-draft furnace has certain advantages which must be defined and explained, if we are to have a complete exposition of the subject. It also has some disadvantages which must also be considered. Taking the advantages first,

they are six in numbers as follows:

SIX ADVANTAGES AND TWO DISADVANTAGES OF DOWN-DRAFT FURNACES.

1. It is, without any exception, the best coal-burning method.
2. When properly operated, it is absolutely smokeless with any coal.
3. Will burn any and every kind of coal.
4. Never troubled by clinkers.
5. Not ever necessary to interrupt the performance for the purpose of cleaning fires.
6. Will produce most economical combustion.

The disadvantages are two in number as follows:

1. First cost is higher than common inefficient apparatus.
2. Successful results depend upon proper manipulation, or in other words, it is a labor problem.

The requirement for efficient combustion of bituminous coal, is that the volatile matter be *thoroughly mixed* with the air at *high temperature*. This occurs with the down-draft principle, as the volatile which is distilled from the upper layer of freshly-ignited coal, must pass in many finely-divided streams between the incandescent coals in the bottom of the fire. At the same time, the air must take the same path, with the result that it is brought intimately and immediately in contact with all the volatile carbon, oxidizing it to carbon dioxide, or CO_2.

This performance differs from that of an automatic mechanical stoker, with which coal is supplied at a uniform rate, and from which the combustible gas rises in the form of masses of flames, which must be kept hot by means of a combustion chamber, until their combustion is completed. Thus the stoker does not produce immediate complete combustion at, or in, the fuel bed, the burning of the gases being a supplemental or secondary performance. The complete mechanical stoker furnace, of course, gives excellent results, but it is a machine which is not applicable to low-pressure heating plants, and it can not burn all grades and kinds of fuel.

NO SMOKE WITH A PROPERLY FIRED HEATER.

The second advantage, that of smokelessness, is a feature that must be considered seriously in connection with the mode of firing. If the heater is properly fired there can be no smoke, but it may easily be so fired that it will smoke outrageously.

As the fuel lies quietly on the upper grate, it burns absolutely without smoke. The fuel bed, however, after a time becomes caked and fused together, with the result that the rate of combustion drops below requirements. When this occurs, the fire should be loosened up. by running a long slice bar *under* the fire along the water bars clear to the *back* of the furnace. The bar should then be pressed down just enough to pry up the fuel bed, sufficient to crack the caked masses, just enough to open air passages, but *not enough to disturb the condition of the fire.* This slicing should be extended across the furnace till the entire bed has been freed and made porous. The insertion of the slice bar will cause some incandescent coals to fall down to the lower grate, where they will be burned later. The slice bar will also dislodge the accumulated ash which will also drop to the bottom grate. After the slicing is finished, the hot coals on the bottom grate will rest in irregular piles, these should be leveled off with a rake or hoe, so that the fire on this grate will be perfectly level and uniform. After this has been done, the fuel bed on the top grate should be replenished by the addition of fresh fuel, which will complete a full cycle of operation. The frequency of these cycles will depend on the load on the boiler; when much steam is required, they should be performed at correspondingly frequent intervals, when little steam is needed, at correspondingly long periods.

EXAMPLES OF IMPROPER FIRING.

Having described proper firing, it is necessary, to explain how the furnace may be, and is often improperly fired. Frequenty the slice bar is only run part way back, then the fire is much broken up and turned upside down on the front, with the result that much green coal falls to the lower grate where it lies in piles, and, burning there, makes much smoke. The back of the fuel bed, not being disturbed, cakes up and at the same time allows the ashes to accumulate which fuse into clinkers. This results also in reducing the capacity of the furnace and producing a mass of clinker which must be dug out, sometimes with much labor. In other instances the entire fire is violently sliced, the fuel bed from front to back turned upside down, with the result that much green coal drops to the lower grate, producing a great quantity of smoke. Sometimes the fuel bed is not sliced at all, or, if it is, only at long intervals. The result of this is that the fire seals up, clinkers form and cover the water bars till not enough steam is made to satisfy demands. Then fresh coal is shoveled on the lower grate and the furnace is operated the same as any plain grate. It is under this latter condition that enormous volumes of smoke are made. Many of the readers of this article may question the accuracy of the statement that the down-draft is a smokeless and efficient furnace when properly operated. Their reason for doubting is possibly because their ideas of its capabilities are based only upon improper operation.

ABILITY TO USE ANY KIND OF FUEL A DECISIVE FEATURE.

Ability to use any kind of fuel that may be available is always desirable, especially under present conditions and particularly so under conditions that will exist in the near future. This is a strong point of the down-draft furnace. It can use successfully bituminous lump, egg, mine run or screenings, as well as semi-bituminous, all on the top grate in the regular way. The only fuel that can not be used is dubb as it is so small that it will fall through the bars. The smaller sizes of washed coal are the least desirable, but they may be used. Coke may be used as well as coal. Anthracite may be burned on the lower grate if it is too slow for the upper fire, as it does not smoke. Under such conditions, the fire door for the upper grate must be closed tight. Wood and like refuse that accumulates at an apartment house and must be disposed of, may be burned on the lower grate.

CLINKER TROUBLE AN EVIDENCE OF BAD FIRING.

One of the frequent complaints that coal dealers receive from users of the down-draft boiler, is that their coal clinkers. There is no reason whatever for such complaint. Clinker trouble is always an evidence of bad firing. With proper manipulation no clinkers are formed on the top grate, even with the dirtiest of screenings. If the fire is properly sliced, all the ash will be dislodged and fall to the bottom grate, where it does, to some extent, fuse together in small clinkers, but these are readily removed as this fire is thin and easily cleaned.

BEST METHOD OF CLEANING FIRE.

The down-draft fire is very easily cleaned, in fact, the easiest to clean of all fires. As all of the ash falls to the bottom grate, it may be easily raked out without in any way disturbing the main fire, which is on the water bars above. The best method of cleaning, however, is to remove a portion of the ash each time the fuel bed is sliced. Just before slicing, the small clinkers should be raked out from the bottom grate, and depending on the amount present, a portion of the ashes may also be removed. The remaining ashes and fire should be

well spread and leveled. Then when the top fire has been sliced, the hot coals which have fallen from the top fire, should be well spread and leveled on the bottom grate. It is better not to remove all the ashes from the grate; about an average amount should be left, because if they are all cleaned off, too much air will flow through the bare grate and reduce the efficiency. So it is best to maintain a thin bed of ashes on the grate to exclude this excess of air.

CONTROL OF AIR SUPPLY AND ITS BEARING ON ECONOMICAL OPERATION.

The foregoing has largely dealt with the matter of securing complete combustion, and the handling of the ash. The matter of the control of the air supply, the feature which applies to the sixth advantage of the down-draft furnace, is the one which has the most important bearing on economy. This requires some detailed explanation. Air contains 21% oxygen and 79% nitrogen. It is the oxygen that does the work, it enters into combination with the carbon and hydrogen of the fuel to produce combustion. The nitrogen takes no part in the process, it acts simply as a dilutent of the products of combustion. Therefore our interest centers in the oxygen, of which about three parts are used for combustion of the hydrogen of the coal. The combustion of hydrogen results in the production of water, which, at furnace temperature, is in the form of steam, and for this reason not easily determined in a chemical analysis of the combustion gases, so is not directly considered in studying air supply.

As three parts of oxygen are used for the hydrogen, there remains 18 parts for carbon. The result of the combustion of carbon is that the volume of the CO_2 produced is the same as the oxygen which entered into the combination. In other words, the oxygen is of the same volume after the carbon is added, as it was before. It is heavier, of course, but not larger. It may be said that the carbon is absorbed by the oxygen. This fact simplifies the analysis of combustion gases, because if our analysis shows 18% CO_2, we know immediately that we have used all of our air in combustion. This would be a perfect condition, the maximum efficiency of combustion, which could be no better. If, however, our analysis shows 9% CO_2, we know that we have supplied twice the amount of air that we have used; in other words, that air is in excess by 100%. If we get 4.5% CO_2, we know that we have supplied four times the air needed or 400%. If 2.25% CO_2 eight times or 800%.

In heating a boiler, practically all the heat which does not go into the boiler,

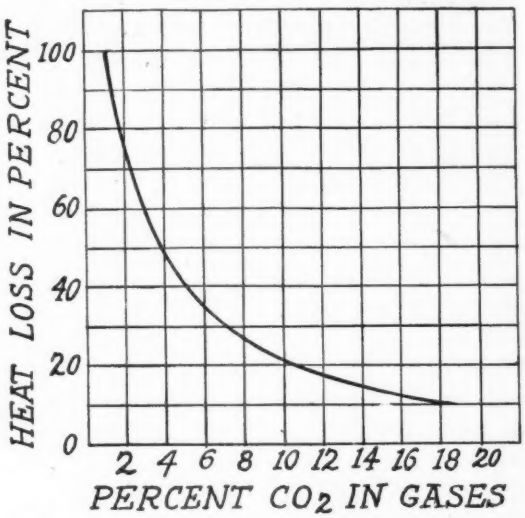


FIG. 1—HEAT LOSSES TO CHIMNEY FOR DIFFERENT PERCENTAGES OF CO_2.

escapes in the hot gases to the chimney. Therefore if we use eight times as much air as necessary, we have eight times more gases to go to the chimney, consequently eight times as much heat wasted. Fig. 1 is a curve illustrating heat losses to the chimney for different percentages of CO_2. It shows that when CO_2 gets down to about 1.5%, the coal being burned does no work at all. An extreme condition, of course, but one which for comparatively short periods often exists.

While the foregoing illustrates the fact of the great importance of proper proportions between air and fuel, it gives

no hint as to how the air may be controlled. We do not see the air and it is difficult to realize that for each ton of coal supplied to the furnace, at least 12 tons of air is also supplied, and that the amount may be, under bad conditions, as high as 100 tons, for each ton of coal. Of course an analysis would give this information at once, but this is out of the question in the kind of service that is under consideration. So it is absolutely necessary that we find some other simple path which leads to the solution of the air supply matter. Fortunately there is such a path. It consists in eliminating from our problem the idea of air, and in its place substituting the idea of draft. Draft is something applying to dampers, ventilators in fire doors, etc., things that every janitor and fireman understand.

AIR CONTROL EXPRESSED IN TERMS OF DRAFT.

A strong draft causes a large flow of air into the furnace, a mild draft a small flow. When a large amount of steam is required, much air is needed, when little steam is needed, little air is sufficient. Thus adjustment of drafts takes care of the air supply matter, as draft and air supply in this connection are synonymous. Now as air supply, or, in other words, draft, must be in proportion to the amount of steam needed, it necessarily follows that fuel must also be supplied in sufficient amount to satisfy this air. The way to do this is to maintain at all times a fuel supply, or a fire condition sufficient to satisfy the maximum draft conditions. Then with strong draft the fire will burn fast, with mild draft it will burn slow. The *efficiency* of combustion will be uniformly high, and the *rate* of heat production in proportion to requirements for steam.

To secure the results above described a sufficiently thick fire must be maintained on the upper grate, to insure that there shall always be an ample supply of combustible to satisfy whatever amount of air may flow through it. In this way the fire-bed becomes a fuel-magazine always ready to respond to any demand, or to lay semi-dormant.

THICKNESS OF FIRE DEPENDS ON KIND OF COAL USED.

The proper thickness of fire depends upon the size of the coal. Screenings, being a small fuel, makes a compact bed, consequently it need not be very thick. Lump coal is a large fuel, is not compact, as there are large interstices between the pieces. With its use the fire must be very thick, or else air will flow through the spaces without coming in contact with burning fuel. Mine-run coal, composed of both large and small sizes, should be maintained at a thickness midway between that for lump and screenings. Holes should never be allowed to form in the fuel bed. The fire on the bottom grate should be kept level and uniform.

The draft-opening at the fire door of the upper grate should be adjusted to give the capacity required. The draft-opening in the ash pit door below the lower grate, should be set so as to admit only sufficient air to uniformally burn the coal that drops to it, the idea being that the fuel on this grate should last from one poking period to another. If too much draft is given, this fire will burn away and leave a bare grate, allowing excessive air to enter. If draft enough is not admitted, the fire will accumulate on this grate.

The draft-openings in the middle door, the one between the grates, should be closed except when wood or rubbish is burned.

The manipulation of the drafts together with the stack damper, either by hand or automatically, to correspond with the load on the boiler, will always give an economical and satisfactory result, if the fire is kept at suitable thickness and in proper condition.

The effect of good and bad firing is illustrated by the curve of CO_2 in Fig. 2,

showing combustion with different kinds of firing. The period taken is six hours, although this time is purely arbitrary and simply assumed for purpose of demonstration. Such diagrams as this are made for the purpose of study and research, and they show in great detail and in a very exact manner, just what happens at any moment. In other words they present the combustion performance

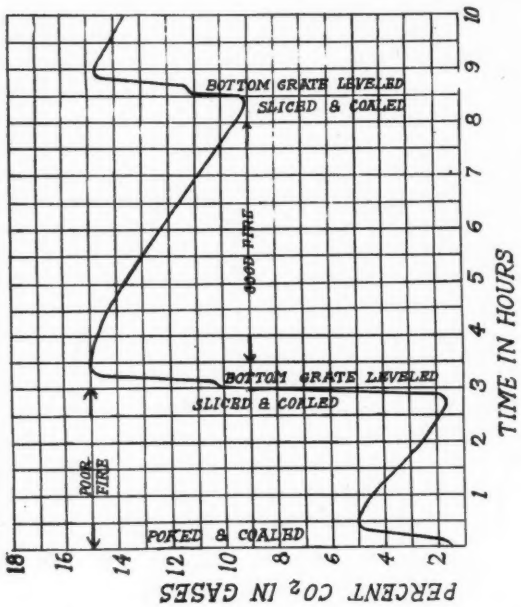


FIG. 2—RECORD OF COMBUSTION UNDER DIFFERENT KINDS OF FIRING.

in a pictorial manner. To get the data to plot a curve like this requires that analysis be made at intervals of two or three minutes, a lot of work, but justified by the value of the educational result.

At the start the CO_2 was 1.5, a little careless poking and recoaling causes it to rise to 5. That it went no higher is because the fuel thickness was not enough, while there were holes in the fire and the bottom grate was not leveled. The result was that in an hour and a half the CO_2 had dropped again to a point at which no steam was produced in the boiler. This interval on the diagram is indicated as poor firing. What the loss for different periods of the hour and a half was is also shown.

At the end of the three-hour period, after some clinkers had been removed from the bottom grate. the fire was properly sliced and coaled which resulted in a rise of CO_2 to 10. The coals on the bottom grate were leveled and drafts set which put it to 15. After this combustion proceeded for about six hours, at which time the CO_2 had dropped to 9%, when the process was repeated. This shows good firing, with an average of 12 CO_2 and an effciency of 82%. While the poor condition averages 3 CO_2, with an efficiency of about 35%.

The down-draft boiler costs a little more than the common one but it has so many advantages that more than justify the additional cost. It also requires a certain higher standard of operation than would pass muster with a common boiler. This, however, does not mean more labor, because the hard part of operating a common boiler is the cleaning of the fire which is very easy with the down-draft. Its higher efficiency requires the use of less coal so that there is less to handle.

Smoke Abatement Activities in American Cities

1—NEW YORK.

By JOSEPH M. LONERGAN,
Assistant Director, Sanitary Bureau, New York City Department of Health.

The enforcement of the ordinance prohibiting the discharge of dense smoke in the City of New York is within the purview of the Department of Health.

The law covering this subject is embraced in Section 211 of the Sanitary Code, which is as follows:

DISCHARGE OF DENSE SMOKE PROHIBITED—No person shall cause, suffer, or allow dense smoke to be discharged from any building, vessel, stationary or locomotive engine or motor vehicle, place or premises within the CITY of New York, or upon the waters adjacent thereto, within the jurisdiction of said City. All persons participating in any violation of this provision, either as proprietors, owners, tenants, managers, superintendents, captains, engineers, firemen, or motor vehicle operators, or otherwise, shall be severally liable therefor.

Heretofore, the City of New York has been a hard coal user. We have been fortunate in our proximity to the anthracite mines of Pennsylvania and accessible to the coal mined there. The present unfortunate coal situation has changed conditions in this city materially, and it is probably true that more bituminous coal is now in use here than ever before.

There are a large number of furnace installations properly arranged and equipped for the burning of soft coal. With these no difficulty is experienced and except in the case of an accident no dense smoke is discharged from them. On the other hand it is unfortunately true that the lack of anthracite coal of the steaming sizes resulted in the alternative of shutting down factory operation or of burning bituminous coal. *With the furnace equipment, and the method of operation based upon the burning of anthracite coal, a shift to bituminous coal generally results in a violation of the law.*

The courts have been inclined to look with leniency upon minor smoke discharges considering the coal situation. This has emboldened a number of factory operators to neglect such precautions as are generally taken for the prevention of dense smoke discharge, with the result that they have become a nuisance to their neighbors. This condition can not long continue, however, as the emission of dense smoke becomes a community proposition in a city like this, and weight of public opinion is rapidly focused on the nuisance. The moral support which follows action by the Department of Health in such cases goes far to determine the court opinion.

PROCEDURE OF THE BUREAU.

The usual procedure in this city is to have a dense smoke discharge noted by a sanitary inspector. If the density of the smoke be established as a violation and the period of emission of sufficient length to warrant further action the inspector makes an inspection of the plant itself, with especial reference to the furnace, equipment and fuel consumed. All information relative to the style of furnace in operation, the character and quantity of fuel used daily, the height of stack, the wind direction, the character of surrounding premises, the names and addresses of witnesses are obtained and recorded on a so-called smoke card.

While the inspector is at liberty to use the Ringelmann chart or the standard smoke tester, it is customary in addition, to establish the density of the smoke discharge and other relevant facts through his testimony and the testimony of witnesses. This is possibly due to

70E—1915 DENSE SMOKE 2979-15-B-5000

Location BUILDING—BOAT—LOCOMOTIVE—PORTABLE APPARATUS—PORTABLE ENGINE

Owner Address

Character or Type

Character of Surrounding Premises

Number of Boilers | Horse Power | Number of Boilers in Use | Horse Power in Use | Draft—Artificial—Natural

Smoke Consumer | Type of Consumer | Character of Fuel

Amount of Fuel Used Daily | Method of Stoking | Dense Smoke Discharged

Duration of Discharge | Date and Time of Discharge | Photograph Obtained

REMARKS:—

NO CAUSE FOR ACTION—NOTICE—ORDER—NUISANCE ABATED BY PERSONAL EFFORT—REFERENCE

191 INSPECTOR-PATROLMAN.

Record of Reinspections on Reverse Side of this Card Censored by on 191

DEPARTMENT OF HEALTH, CITY OF NEW YORK. SANITARY BUREAU, BOROUGH OF

FORM OF "SMOKE CARD" USED BY SANITARY BUREAU, NEW YORK DEPARTMENT OF HEALTH.

the liberal construction placed upon the statute by court decisions.

Photographs are obtained of the stacks in question, showing the smoke discharge and additional views are secured of the conditions surrounding the plant, showing where possible the premises which are affected by the smoke.

With the establishment of the violation it is customary, except in the instance of certain persistent offenders, to serve a notice requiring that the discharge of dense smoke be discontinued forthwith. Subsequent inspections are made and if the violations continue the plant owner's attention is called to the existence of the notice, by a police officer of the sanitary squad, and the owner is warned that any further continuance of the nuisance will result in legal action by the department. If the nuisance still be unabated, the corporation counsel's office sends the owner notice of intention to start a criminal action for punishment for a misdemeanor. This is followed by legal action when necessary.

It will thus be seen that a case in court is not predicated upon one or two smoke discharges, but upon a nuisance existing for a considerable period of time. The owner of the offending plant is given every opportunity to correct any condition in his furnace operation or equipment deemed necessary and is re-

DATE	TIME	RESULT OF INSPECTION	NUMBER OF NOTICE or REPORT	INSPECTOR

REVERSE SIDE OF "SMOKE" CARD.

peatedly warned of the result of his failure to comply.

We believe that as smoke means waste, an emission of dense smoke is an unpatriotic act upon the part of the plant owner. The national crisis into which we are plunged demands the saving of all of our resources and especially of fuel. That this is possible is no longer open to doubt. This can not be proved better than by the act of a plant owner in this city who permitted his plant to discharge dense smoke until the witnesses and photographers had started their observations of his chimney stacks. Faced with vigorous court action he corrected his methods of operation and today is running at maximum speed without the discharge of dense smoke.

A recent decision of the higher courts of this State sustaining this department in cases against boats discharging dense smoke while plying the waters of the city, has given an added impetus to smoke preventive work. As a result several of the steamboat companies have engaged specially skilled firemen to instruct their stokers in proper methods of firing. As a high percentage of dense smoke discharges are traceable to improper firing, this is a step in the right direction.

While the number of automatic stokers, etc. installed as a result of the department's campaign against the discharge of dense smoke is large, there are three plants which are now being altered to secure compliance with the ordinance, worthy of special note. These are the Brooklyn Navy Yard, the Brooklyn Rapid Transit Power House, and the Long Island City power house of the Pennsylvania Railroad.

One-half the plant at the Brooklyn Navy Yard has been equipped with underfeed stokers and orders have been placed to install this style of stoker in the balance of the plant at a cost of about $29,000. There are 72 underfeed stokers going in at the Brooklyn Rapid Transit Company's plant, and the same style of stoker, to cost about $50,000 is being furnished for the Pennsylvania Railroad power house.

Following is a summary of the department's court actions for violation of the smoke ordinance during the past three years.

Year	Arrests	Discharged	Fined	Sentence Suspended	Imprisoned	Amt. of Fines
1914	171	104	49	15	1	$1,430.
1915	258	35	161	39	2	670.
1916	78	11	41	23		504.

Discrepancy in total of results due to cases pending at end of year.

"Discharged" represents cases dropped as a result of compliance with the law.

2—PITTSBURGH.

By J. W. HENDERSON,

Chief of Bureau of Smoke Regulation, City of Pittsburgh, Pa.

In Pittsburgh the work of abating the smoke nuisance has been particularly effective during the four-year period of the present city administration which terminates with this year, 1917. Enforcement of the law is in direct charge of the Bureau of Smoke Regulation in the Department of Public Health. The work has been most interesting and particularly instructive as a study of men to us who have been new to the work of enforcing compliance to law and trying to do this impartially. It has been found that, after all, men are pretty much on a common level when their self-interest is touched in any manner, even for the general welfare of the community including themselves.

EXCUSES FOR NOT COMPLYING WITH LAW.

During this period commencing with 1914, we have been offered four reasons why the law should not be enforced. And this too, by influential, respected, intelligent and cultured men. Here they are:

1—No business.
2—Too busy.
3—Shortage of Labor.
4—War contracts.

At our last public meeting, July 26, held in the rooms of the Chamber of Commerce of Pittsburgh, these four reasons were spoken of, analyzed and shown to be the specific and direct reasons WHY THE LAW AGAINST "THE PRODUCTION AND EMISSION OF SMOKE FROM STACKS" SHOULD BE ENFORCED and complied with. Space forbids detailing our analysis of these questions. The reader can do this for himself. He has but to know that when plants are not busy is the time for improvements; that when they are busy with unfilled orders is the time to make changes that will increase production; that proper equipment will relieve labor from non-productive work, shoveling coal, etc., for use on productive effort; and that war contracts will be better taken care of as to quality and time of delivery, and that intelligent SMOKE PREVENTION ACCOMPLISHES ALL THESE DESIRABLE ENDS, to solve the questions for himself.

Our work in Pittsburgh has been productive of results due to a consistent policy of co-operation and publicity. That co-operation has been brought about mainly through public meetings with the owners and operators of stacks and public talks under the auspices of the Smoke and Dust Abatement League. The Civic Club of Allegheny County, the Chamber of Commerce and various clubs, and with ample space being given the work by the newspapers of the city.

PROSPECTIVE GAS SHORTAGE A FACTOR IN SECURING DESIRED FURNACE CHANGES.

Pittsburgh is not entirely free from smoking stacks. In fact, if all the stacks in the city were just within the limits provided in Ordinance No. 566, which allows smoke emission for about 13% of the time, the atmosphere would not be in a very desirable condition. It so happens that the effort to comply with the law brings about smokelessness that

FIG 1.—VIEW OF PITTSBURGH TAKEN MAY 20, 1914, AT 11:10 A. M., ON ONE OF THE FOUR DAYS OF CONTINUOUS DENSE SMOKE.

FIG. 2—ANOTHER VIEW OF PITTSBURGH TAKEN AT 11:17 A. M., MAY 20, 1914.

in many cases is practically continuous. The number of such instances and those approaching it, is increasing almost daily. The prospective gas shortage this coming winter and bringing prosecutions during June and July this year, against certain persistent violators of the law, has stimulated activity in the making of changes to furnaces and stacks, to bring them into compliance with the city ordinance. Incidentally, we can state unqualifiedly that there is not a boiler-furnace or metallurgical furnace that can not be changed so as to comply with the law and generally with profit in the way of economies and increased production.

BETTER ATMOSPHERIC CONDITIONS REPORTED BY WEATHER BUREAUS.

A witness to the progress of smoke

FIG. 3—PITTSBURGH UNDER PRESENT-DAY CONDITIONS.

abatement in Pittsburgh can be found in the U. S. Weather Bureau's local office which has been tabulating atmospheric conditions which it designates as "dense smoke" and "light smoke." Whenever such atmospheric conditions are present for an hour or more in any day, a record is made of the fact. The results by half yearly periods are as follows:

First six months.

	1912	1913	1914	1915	1916	1917
Dense smoke days	29	21	13	13	9	6
Light smoke days	64	64	50	46	41	44

The dense smoky days are the kind that gave the city its old title relating thereto. During May, 1914, there were four consecutive days during which the atmosphere was such as to be recorded as "dense smoke" all day long. There has not been a repetition of such occurrence since that time, notwithstanding that coal consumption has been increased fully threefold during 1916 and 1917, as compared with 1914 and during the previous years. It is also noteworthy to state that whenever the humidity is high and the wind velocity low, the conditions are right for producing an atmospheric condition such as is recorded by the weather bureau.

When that has been the case during the past three years, the number of hours of duration has been lessening so that almost invariably the atmosphere is cleared up before ten o'clock in the morning. The wide publicity given this change that has taken place in our city, has attracted inquiries about it from all over this country, Canada and from England, Australia, India and Japan. Evidently, only a continuance of the policy of absolute impartiality in all cases, will maintain the progress made and continue the good work.

The smoke nuisance is a continental problem that can not be separated from the questions as to public health, labor shortage, the progress of the war and the conservation of the natural resources of the country, for war purposes and for the general welfare after peace shall be declared. The United States Government should add smoke regulation to its program of activities. The work is of too much importance to leave to the changing policies of city, county and State governments.

The question has been brought to the attention of a member of the President's cabinet and to some members of Congress. Anybody can make smoke. The problem is to be able to make it when there is some definite purpose in view and *then* not to have it pouring from stacks when it not only is not performing any useful function, but is representing a distinct loss to all the people. Will the United States Government undertake the task?

3—CINCINNATI.

By WALTER M. SQUIRES

Superintendent of The Smoke Abatement League of Cincinnati, O.

Of the many and vital problems confronting every city, whether it be large of small, the problem of smoke abatement is rapidly assuming a place in the front rank.

Cincinnati, founded in 1788, began using soft coal at once in her dwellings and factories. As years passed the smoke evil became greater and was more clearly recognized but it remained for an agitation begun by the ladies of the city, headed by the late Dr. Julia L. Carpenter, to secure our first anti-smoke ordinance, which was passed in November, 1881. With the exception of Chicago, we were the first great American city to take such action. Even then it was a dead letter for a quarter of a century and things got to such a pass that public opinion demanded that something be done. The

Smoke Abatement League, organized in 1906, was the result.

The Smoke Abatement League of Cincinnati, as an organization, is, undoubtedly, one of the most unique institutions of its kind in the country. Though wholly without endowment and deriving no revenue whatever excepting from voluntary contributions, it has never borrowed a dollar at the bank or given a note; has no debts; but collects from the public in advance sufficient funds to meet its needs. Annual dues are only $5.00 and many of our leading physicians, attorneys, business men, firms and manufacturers are members. Its staff of inspectors is composed of men all trained in the theory and practice of smoke abatement, capable not only of making observations but also to visit power plants and instruct the firemen as to the proper method of operating his furnace and also, when found necessary, to diagnose the furnace conditions and give suitable recommendations for alterations in their design.

LEAGUE WORKS WITH CITY SMOKE INSPECTION DEPARTMENT.

A thorough spirit of harmony and cooperation exists between the league and the city smoke inspection department. This does not only exist in theory but also in practice. The city has been divided into districts, one of which is supervised almost exclusively by the league, and practically all smoke abatement work in this district is left to its discretion. The office is established on the 29th floor of the Union Central Building and it is possible to make observations for the entire basin of the city from this point.

When a stack is seen smoking excessively the plant is immediately notified by telephone and the responsible party cautioned. This has been a great aid in breaking up carelessness on the part of the operators, for they soon became aware that they are under almost constant supervision. However, when this fails or satisfactory results are not secured, the plant is visited and a determination made as to the cause of the smoke. If the operator is at fault, he is again cautioned and advised that another repetition of the offense will mean court action. If it is determined, however, that he could not avoid making the violation owing to faulty design of or obsolete furnaces, the owner is called into consultation and requested to make such changes as are deemed necessary and a reasonable length of time is granted him to make them. The owners have found that the changes they have been required to make have not worked a hardship upon them, but instead, in nearly every case, have been a source of revenue through lessened fuel bills, often to such an extent that the money expended in making changes has been speedily returned. Frequently solicitations for assistance are made to us.

Court action is used only as a last resort or when all other methods fail. Co-operation is the keystone upon which any success we may have had is laid. That the smoke inspection forces are securing results in their efforts to rid the city of the smoke nuisance is evident from the fact that within the last four years fully 75% of the smoke from the factory, power and office buildings and locomotives has been abated.

During the winter months there is still a great deal of smoke from old, obsolete equipment which, apparently, can not be prevented except by the complete removal of said equipment from service and replacement with the new smokeless types of furnaces that are now available. The league is at present engaged in this work and is hopeful of success.

The Economical Purchase and Use of Soft Coal for Heating Homes

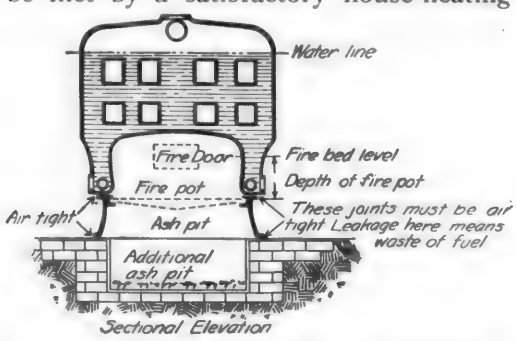
A timely circular on the purchase and use of soft coal for house heating purposes has recently been compiled by the Engineering Experiment Station of the University of Illinois. Among other things, the more important factors involved in the installation of a satisfactory and economical house-heating system are discussed, and the most economical methods of firing soft coal and operating a house-heating plant are presented. For the convenience of the house-holder who desires to place his heating system in proper condition to derive the benefits of great economy from its operation, the most vital installation and operating requirements are summarized.

The order in which the several phases of the subject are discussed corresponds with that in which the householder normally considers them. In the early summer he looks over his heating system to see that it is in proper condition for the next heating season; next he purchases his coal; finally he is concerned with the problem of operating the system in a manner which will produce the best results.

The information contained in the circular was compiled under the direction of a committee of which A. C. Willard, assistant professor of Heating and Ventilation at the university, was chairman.

After discussing the requirements to be met by a satisfactory house-heating installation, as shown in Figs. 1, 2 and 3, the circular takes up the arrangement of heaters for burning soft coal. Soft coals, it is stated, which swell when heated and also coke, which is more bulky than coal, require larger fire boxes to permit a sufficient amount of fuel to be fired to last between reasonable firing periods. Fire-pots for soft coal, in many types of heaters, especially warm-air furnaces, are slotted (Fig. 4) or have a special air supply ring (Fig. 4) at the surface of the fire to introduce heated air, and thus to provide for more nearly complete combustion of the gases which come from such coal.

Down draft, cast-iron and steel heating boilers (Fig. 5) are now manufactured, and are used in large residences and apartment houses for burning soft coal without smoke, or with reduced quantities of smoke. In these boilers air is supplied *from above* to the fuel, which is burned on a grate composed of hollow bars or tubes containing water. This grate is so placed (Fig. 5), just above an ordinary direct-draft grate, that the volatile gases from the freshly-fired fuel



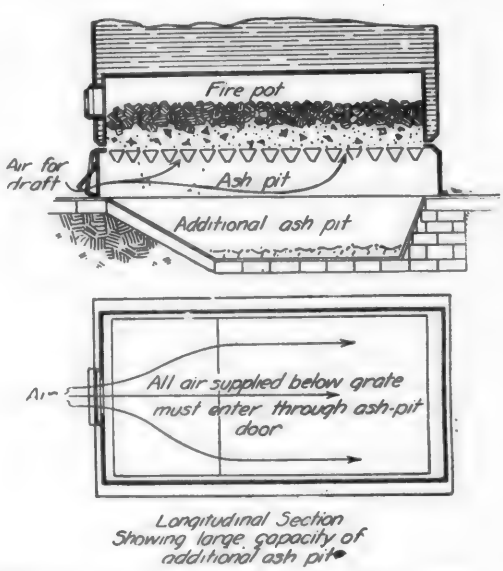

Fire pot
Air for draft
Ash pit
Additional ash pit
All air supplied below grate must enter through ash-pit door
Longitudinal Section Showing large capacity of additional ash pit

FIG. 1—APPROVED METHOD OF SETTING STEAM AND HOT WATER BOILERS TO PROVIDE ADDITIONAL ASH PIT.

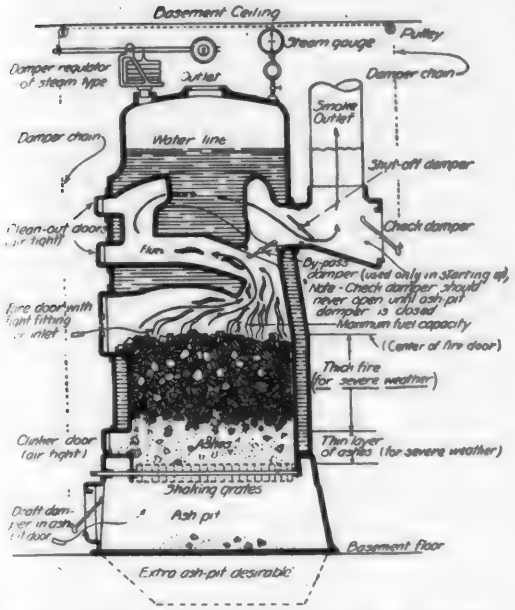


FIG. 2—TYPICAL STEAM BOILER, SHOWING NECESSARY DAMPERS AND DOORS.

on the upper grate *pass down* over the hot surface of the thinner well-coked fire which is kept brightly burning on the lower grate. The fire on this secondary or lower-grate fire acts, in the presence of sufficient air, to ignite and burn the volatile smoke-producing gases and sooty products which would otherwise pass through the flues of the boiler and up the chimney unburned.

In this way, not only are the actual smoke-forming products consumed when the furnace is under proper regulation, but all the other burnable gases are completely consumed in the boiler itself, so that more heat per pound of fuel is made available for heating the building.

HINTS ON CHIMNEY CONSTRUCTION.

The circular has some good hints on chimney construction. The use of fire-clay flue-lining throughout the length of the chimney is recommended, both on account of tightness in connection with air leakage but also as reducing the risk of fire in the chimney.

Covering for warm-air pipes, as well as for steam and hot water piping is recommended. For air, a 3-ply asbestos

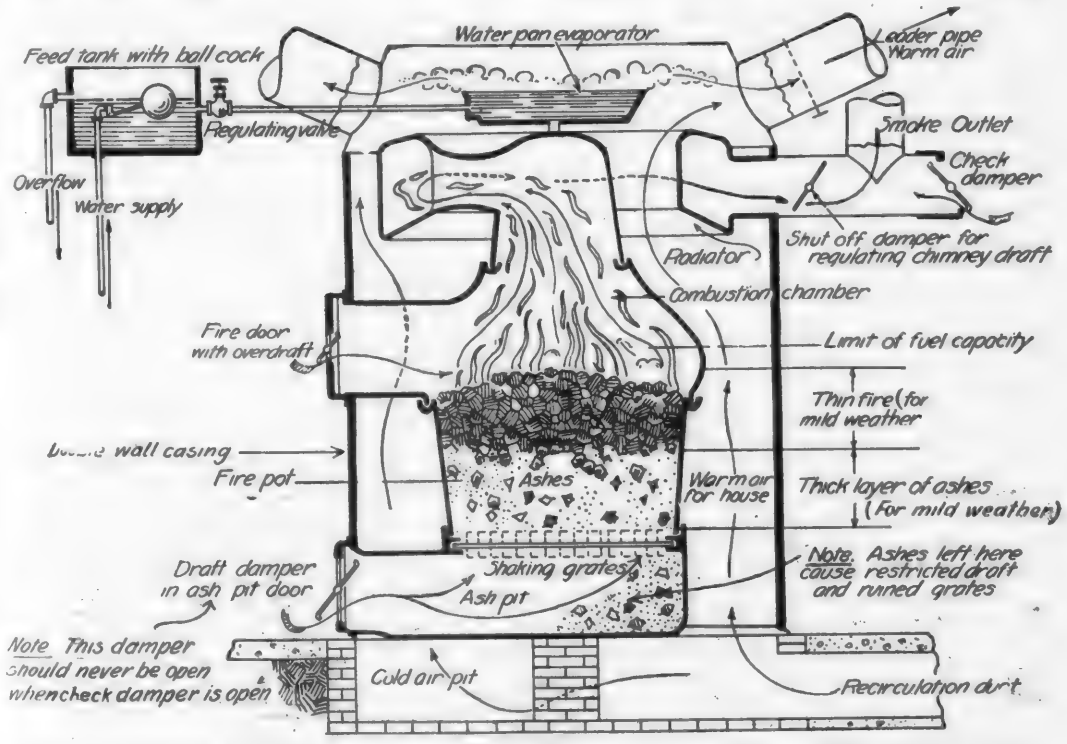


FIG. 3—TYPICAL WARM-AIR FURNACE, SHOWING DOORS AND DAMPERS FOR PROPER REGULATION.

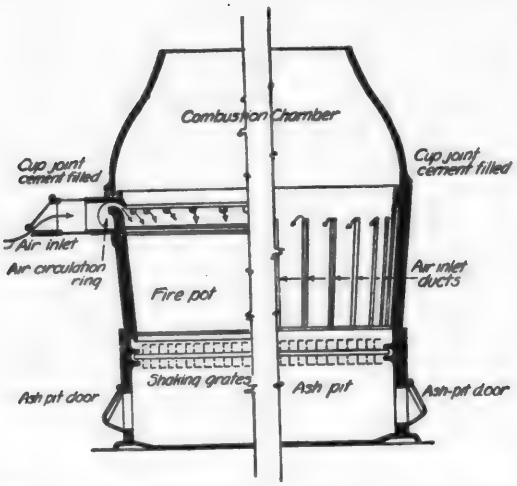


FIG. 4—TWO TYPES OF FIRE POTS FOR BURNING SOFT COAL WITH AIR SUPPLIED ABOVE THE FUEL BED.

paper covering at least ¼ in. and preferably ½ in. in thickness is desirable.

Recirculation of air in warm-air furnace systems is endorsed by the committee. The recirculating duct, taking air from the front hall, instead of from out-of-doors, must be large and practically equal in size to the combined area of the warm-air leaders coming from the furnace.

THE HUMIDIFYING REQUIREMENTS.

For supplying the necessary amount of moisture to the air, it is recommended that warm-air furnace systems be equipped with an evaporating tank or pan placed above the dome and just beneath the bonnet of the furnace where "it will receive heat enough to evaporate sufficient water effectively to humidify the air going to the rooms." An automatic ball-cock or feed-valve should be arranged in an external float-tank to keep the evaporating pan constantly supplied with water. A hand-control valve is needed on the line supplying the evaporator, and an overflow should be run from the float-tank. In very cold weather, with the furnace running at full capacity, the hand-control valve must be partially closed at times; otherwise too much water vapor will be sent into the house and the windows will become covered with frost. "The average water pan placed near the bottom of the jacket of warm-air furnaces," says the report "is ineffective as a means of humidifying the air in a house."

As regards the equipment of steam and hot water heating plants with humidifying apparatus, it is stated that a satisfactory humidifying system is a more expensive item than in warm-air furnace heating. Water pans on radiators are not generally capable of supplying sufficient vapor to be of any real value. This deficiency is especially true in the case of hot-water systems, in which the radiator temperatures are lower than in a steam

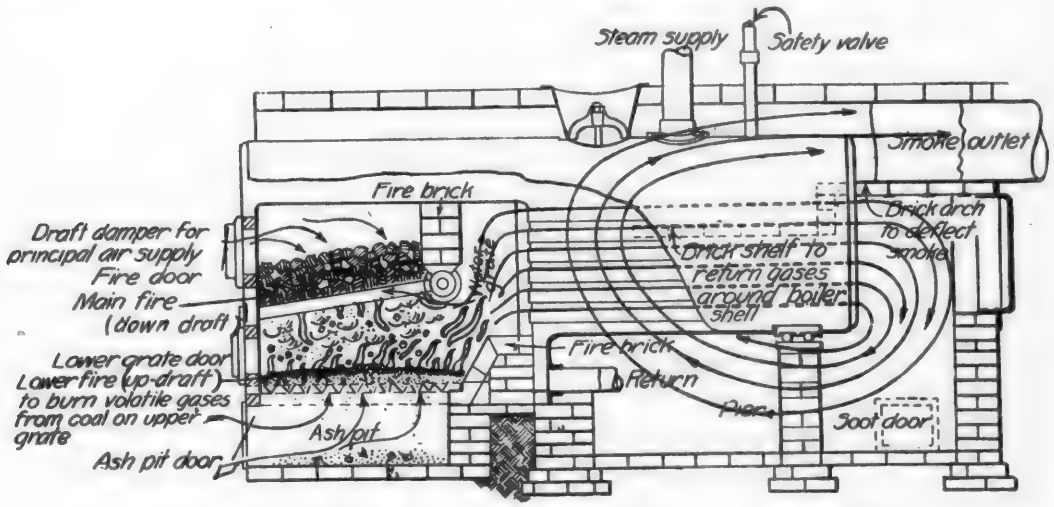


FIG. 5—TYPICAL DOWN-DRAFT BOILER FOR BURNING COAL WITHOUT SMOKE.

system. With a steam plant special valves or cocks may be connected into the steam pipes or radiators and may be used to "bleed" or supply steam direct from the system to the air of the room. This can be accomplished quietly, and if the valves are regulated in accordance with fluctuations in the outside temperature so as not to admit an excess of vapor, frosting of the windows can be prevented and a proper air condition maintained.

There is no simple and effective way of humidifying the air with a hot-water system. Recourse may be had to a large pan of water kept simmering on the kitchen stove with doors between rooms left open as a partial solution of the problem.

THE PURCHASE OF COAL.

Among factors to be considered in the purchase of coal, attention is called to the fact that many users of large amounts of fuel buy their coal on the heat unit basis. It is pointed out that the case with the householder is slightly different from that of the large user. While the heat value of a coal is still the most important thing to be considered, other characteristics and factors have a relatively greater bearing upon the problem of the householder than upon that of the large user. The value of a fuel in a house heater is not dependent entirely upon its B. T. U. value, but to a considerable extent upon the skill of the fireman, the design of the furnace, the method of firing, and the several properties of the coal. For example, careful firing and attention will yield as good results with an 11,000 B. T. U. coal as indifferent methods of firing will produce with a 12,000 B. T. U. coal. Widely different varieties of coal should not be compared solely on the basis of their heating value. The greater convenience in handling and firing, lack of smoke and dirt, and the method of burning are all qualities which distinguish, for instance, the eastern coals from the Illinois coals and make them more desirable. How great a difference in price the householder is justified in paying for these advantages is, of course, a matter of the individual to decide for himself.

With reference to the selection of dif-

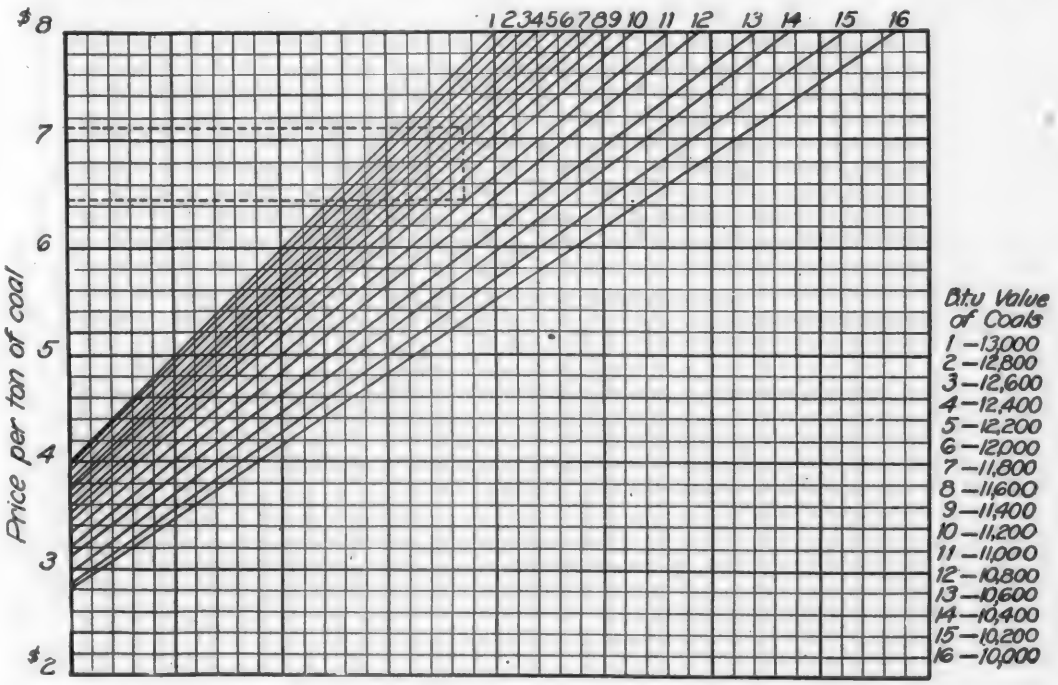


FIG. 6—THEORETICAL VALUE OF COALS OF DIFFERENT HEATING VALUES AT VARIOUS PRICES PER TON.

ferent Illinois coals, the B. T. U. value and the percentage of ash furnish a general guide to their relative values. The ash content directly affects the B. T. U. value, so that the relative value may be expressed with fair accuracy by the B. T. U. value alone, although the efficiency of any coal drops off more rapidly than its B. T. U. value when the ash content exceeds 10% or 15%.

In order to enable the small consumer to judge as to the relative values of coals offered at different prices, the chart, Fig. 6, has been prepared to show the theoretical value of coals of different heating or B. T. U. values at various prices per ton. A close approximation of the percentage of actual heat-producing material in Illinois coal may be obtained by dividing the B. T. U. value of the coal by 155. Thus, a 12,000 B. T. U. coal contains 12,000 ÷ 155, or 77% of heat-producing material.

The householder should remember that the B. T. U. value, as shown by the test of a selected lump or properly-taken mine sample does not necessarily coincide with the B. T. U. value of the coal as delivered. Ordinarily, the heat value of well-prepared coal purchased from reputable dealers does not vary more than 4% or 5% from the analysis of the mine sample. Advertised values based on "selected" samples may, however, prove misleading. Unscrupulous dealers sometimes takes advantage of the householder's lack of technical knowledge and deliver poorly-prepared or improperly-sized coal which may be greatly deficient in heating value. The precautions which a householder may take against such a risk are: (*a*) buy from dealers who are known to be reputable and responsible, (*b*) examine the coal to see that it is free of impurities and is properly sized, (*c*) in an extreme case, in which the quality of the coal seems to have been grossly misrepresented, have a sample taken and analyzed by a qualified fuel chemist who understands the correct method of sampling.

DRAFT CONTROL FOR ILLINOIS COAL.

In order to operate any system of heater drafts successfully, especially with Illinois soft coal with which the circular is chiefly concerned, certain fundamental facts must be understood.

Due to the suction or draft action produced by a good chimney there is a constant tendency for air to enter any opening into the ash pit, combustion chamber, or smoke pipe of a house heater. It is, therefore, necessary to have all such openings controlled by tight-fitting dampers.

Air must be supplied in varying quantities, ranging through wide limits, in order to burn the fuel economically. With Illinois coal this variation in amount of air required is large and requires careful attention. It is greatest soon after firing, from which time it should be gradually decreased until the next charge is fired.

Air may be supplied either above (through fire door, Fig. 3 or through special slots or ports) or *below* (through ash pit door—Fig. 3) the burning fuel bed, and sometimes both above and below the bed. Immediately after firing soft coal, when the most air is needed, some air must enter above the fuel bed in order to burn the large amount of volatile matter given off from the fresh or "green" fuel charge and to provide sufficient oxygen to insure the burning of the combustible carbon gases given off from the fuel bed. Failure to supply air for this purpose will result in a considerable loss or waste of heat. As soon as this gaseous matter is burned off (the fresh fuel will have become more or less bright on top by this time) the over-draft through the fire door should be partly closed and the ash-pit damper left partly open. In mild weather, both the ash-pit damper and the overdraft should be closed to prevent the coked fuel now left in the fire from burning out too quickly.

In case the fire must be checked still further, as is true for most of the heat-

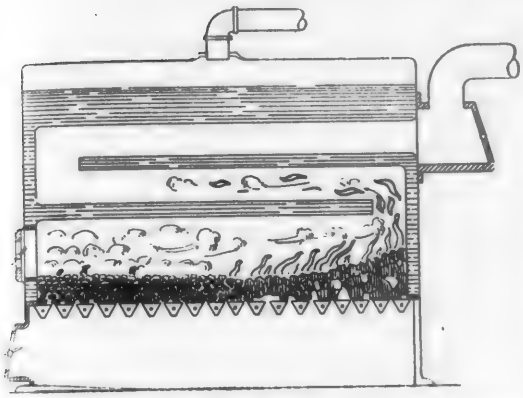


FIG. 7—FIRST STAGE OF COKING METHOD OF FIRING.

ing season, the check damper (Fig. 3) in the smoke pipe must be opened in order to decrease the draft or suction action of the chimney by admitting cold air directly into the flue. This is the case when the fire is to be carried overnight without burning out, but there should be no attempt to "hold" a fire in this way unless there is a good bed of fairly well coked fuel already in the fire pot. Always let a fresh fuel charge burn up somewhat, with overdrafts at fire level open, before attempting to carry it for a considerable period with an open check-damper.

In order to promote economy, fire at fairly regular intervals, and put on comparitively small charges of coal frequently rather than large charges at much longer intervals. It is recognized that infrequent firing of large quantities of coal may be the more convenient method, but such convenience can, with the ordinary heater, be obtained only at the sacrifice of economy. Large charges of coal and infrequent firing will increase the chimney losses due to the production of unburned gases just after firing.

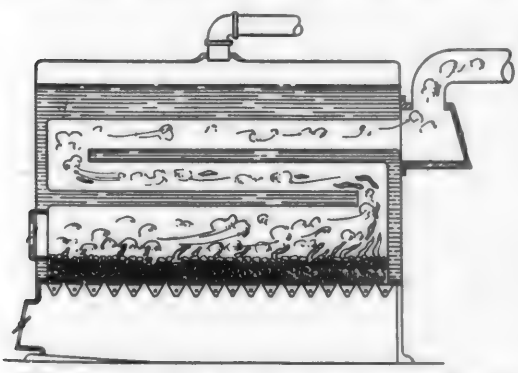


FIG. 8—SECOND STAGE OF COKING METHOD OF FIRING, WITH NEWLY-COKED FUEL SPREAD OVER ENTIRE FUEL BED.

Employ the coking method of firing (Figs. 7 and 8) in so far as possible that is, spread the fresh coal upon a portion of the fire bed only, leaving a portion of the fire glowing brightly (Fig. 7) so that the gases which rise from the freshly-fired coal may be quickly ignited. As soon as the fresh coal has been coked it should be spread out over the entire fuel bed (Fig. 8). It will then burn as a bright fire without further smoke (Fig. 9).

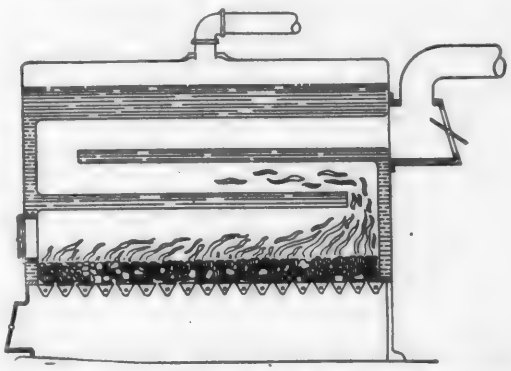


FIG. 9—THIRD STAGE OF COKING METHOD WITH ENTIRE FUEL BED INCANDESCENT.

Those heaters which have fire-pots sufficiently large to permit the effective use of the coking method of firing by depositing considerable quantities of coal on one part of the fire bed while the other is glowing and carrying on the combustion can be most economically employed for house heating. Many house heaters have fire-pots which are too small to make possible the use of the coking method and its economy.

Keep a fairly thick fire bed, with the surface of the fire well up in the heater. This keeps the fire in the best condition to radiate heat to the heat-absorbing surfaces and prevents the loss of coal to the ash pit. More ashes can, of course, be carried in the lower part of the fuel bed (Fig. 3) during mild than during cold weather. Do not poke or stir the fire as this is likely to produce clinkers

and to cause greater losses both to the ash pit and to the chimney. For the same reason excessive shaking should be avoided. If clinkers are produced, they should be removed with as little disturbance of the fire bed as possible. Keep the ashes away from the under side of the grate. Their presence may prevent the inflow of sufficient air, or may deflect the air admitted through a part of the fire bed only. This condition not only interfers with the proper combustion of the coal, but may also result in burned-out grates.

CARE OF THE HEATER IN SERVICE.

The heater while in service should be kept in good repair throughout. Soot and ashes in the flues or gas passages prevent the heat from passing to the water, steam or air which is to be heated. Flues should be thoroughly cleaned at regular intervals. Some heaters should be cleaned every day, while in general a cleaning about once a week is sufficient. Soot and ashes upon the heating surfaces not only prevent the passage of heat, but may so clog the flues as to interfere with the draft action and thus make satisfactory operation of the heater impossible.

WHY SMOKE IS AN INDICATION OF LOSSES.

While tests have shown that the actual heat value contained in smoky discharges from the chimney is not very much greater than that contained in discharges which are not smoky, the presence of smoke usually indicates careless methods of firing or improper regulation of dampers with their attendant losses and wastes. If your chimney smokes continually or too freely, you may be sure that unnecessary losses are taking place.

Civic Phases of the Smoke Problem

By JOHN J. O'CONNOR, JR.,

Assistant Director Mellon Institute of Industrial Research University of Pittsburgh.

The problems of modern cities are largely industrial problems. Ancient cities were founded around religious, political or trading centers; modern cities were founded at points where raw materials could be secured or easily assembled for the making of goods. If cities have failed to solve their problems it is not so much the fault of theories of government, as it is that industry has failed in service.

The industrial life and with it, of course, the very existence of a great many of our cities is predicated on coal consumption. It is, therefore, not in the least surprising that cities have found great difficulty in solving a problem which arises out of coal consumption—the smoke problem.

Nevertheless, American cities have long recognized the existence of the problem and have attempted to cope with it. As early as 1804 the burgesses of Pittsburgh called the attention of the borough council to the smoke evil. It was not until 1881 that cities made the smoke nuisance a subject of legislation. Chicago passed the first general ordinance in April of that year and Cincinnati the following November. Legislative enactments have gone on until now all cities which burn large quantities of bituminous coal for industrial purposes have smoke abatement ordinances. The enactment of so many ordinances may indicate a widespread, live interest in the smoke problem, or it may point to a surpassing faith in the power of legislation.

THE SMOKE NUISANCE HAS BECOME A COMMUNITY PROBLEM.

At all events, the concept of the smoke problem has changed. That is the important and hopeful sign. That which was a nuisance and the abatement of which was to be secured by the establishment of facts in each individual case has become the smoke nuisance—a community problem. The establishment which now makes objectionable smoke is not looked upon as causing injury or annoyance only to the individual who happens to live next door to it, but to the whole community. Therefore, when the smoke inspector proceeds against the violator of the ordinance he is doing so not on behalf of either a cranky, pesky, irrational or jealous individual, but on behalf of the community.

Another way of expressing this new concept is by saying that more and more emphasis is being placed on a "diffused smoke nuisance"—a whole city enveloped in smoke—as distinct from a "local smoke nuisance"—a single or a few stacks in the same vicinity pouring out smoke.

SMOKE PREVENTION SAVES 20% OF THE HEAT VALUE OF FUEL.

This new concept has been formed because cities are having it impressed upon them and are beginning to realize that the smoke nuisance is a serious obstacle to any kind of city planning, that it destroys building materials, retards the growth of vegetation, cuts off sunlight and daylight, prolongs fogs, is injurious to comfort and harmful to health, and is costly both to the smoke maker and to the public. The last point in the indictment of the smoke nuisance —that it is costly both to the smoke maker and to the public—is one which should be thoroughly understood, for very often persons in favor of smoke abatement are accused, as it were, of placing explosives beneath the foundation of industry. The bituminous coal consumption of this country is something over 400,000,000 tons which is valued at least at $800,000,000. It is conservatively estimated that 20% of this coal consumption goes up the chimney as tribute to "King Smoke." This means a loss of about $160,000,000 annually.

That is not all. On the basis of the average cost of the smoke nuisance for cities, in which estimates have been made, the annual cost to the people who live in what the United States census terms "urban territory" is about $550,000,000. Cities have every reasons to relieve their citizens of the burden of this tax.

Again, city assessors and the courts have taken cognizance of the fact that the smoke nuisance reduces rents, increases the difficulty in letting houses and decreases the selling price of properties, especially in residential sections.

INDUSTRIES NOT DRIVEN AWAY BY SMOKE LAWS.

There is another point on the economic side. It refers to the old cry about driving out business. This cry is often raised when some offenders are hard pressed. It it then asserted that if the smoke ordinance is enforced, manufacturing plants will be compelled to move elsewhere. There is no evidence to support this threat. On the contrary, there is abundant proof that the smoke condition of the atmosphere keeps certain very desirable industries from locating in smoky cities and, in the second place, it imposes a heavy tax on industries already located in such cities.

A consideration of these points leads to the conclusion that the abatement of the smoke nuisance, unlike many other social nuisances, against which outcry has been made, would result in direct and immediate gain both to the public at large and to those who are chiefly responsible for it.

Cities of this country are doing much to solve the smoke problem, but the citi-

zens have every reason to demand and to bring pressure to bear that the process be accelerated because of health, welfare, comfort and the things which make for civic betterment.

THREE WAYS TO MAKE SMOKE PREVENTION WORK MORE EFFECTIVE.

It may not be out of place at this point to make three suggestions as to how this acceleration may be brought about:

The first one is that a city administration should take an active interest in the smoke problem. It is not outside of its duty nor beneath its dignity to do so. The interest should take the form of constructive suggestion and encouragement, not a contemptuous tolerance of the bureau, pernicious interference on behalf of favorite offenders or the sending out of the edict "go easy." Any municipal activity breaks down at the point where favoritism enters. Unfortunately it is sometimes true that the smoke inspector does not secure more co-operation from the city administration because he, himself, does not take the proper attitude on the smoke problem. He often thinks that his is somehow a hopeless and thankless job and the best he can do is to let "bad enough" alone. The smoke problem calls for broad men, men who have a sound fundamental training, men of imagination and men of force.

The second suggestion is that a city should know what its problem is. This may sound foolish, but there are not more than two cities in this country which have the information on which to base a serious campaign against the smoke nuisance. A city should know what its coal consumption is and its relation to the smoke problem. It should have exact knowledge as to the general sources of smoke and a good idea of the amount of smoke made by each source. It should know the location of all stacks and have all significant data on the kinds of installation under them. It should place special emphasis on securing facts as to the ability of the different installations to abate smoke. It should spare no expense to secure evidence with which to convince the most hardened offender of the smoke ordinance that the emission of dense smoke is both wasteful and harmful.

The third suggestion is that with such information a city should diagnose its problem and plan broadly and deeply for its solution. For this purpose the ordinance should be studied to find out whether or not it was simply copied from that of another city or was adapted to the problem at hand. It should decide how much emphasis is to be placed on the abatement of smoke and how much on the prevention of future smoke. The organization of the smoke department should be worked out with reference to the extent and nature of the problem. If it is possible, the smoke bureau should be separated from other activities and set off by itself. This will give to it dignity, obtain for it the proper attention and concentrate responsibility.

Above all, plans should be laid to secure the co-operation of all civic and commercial organizations and institutions of learning that a solid front may be presented in attacking the smoke problem. This is important, whether the plan of procedure is to be one of education or prosecution. No municipal activity in this country is developed sufficiently to reach its goal without the help of organizations which have the welfare of the community at heart. The assistance, the criticism and the approval of civic organizations should be sought after and prized. Institutions of learning in which reside the sciences which have solved so many municipal problems should be recruited for the fight, and the students of engineering schools should be impressed with the necessity of giving attention to problems of combustion. All the forces that are in a community should be called into action to help to solve one of the most difficult problems which confront municipalities.

To summarize: Most of our civic problems are problems of industry—problems concerned with our very existence. The smoke problem is such a one, and for that reason, if for no other, is difficult to solve. Cities are coming to take an increased interest in it. This is due to the fact that points in the indictment of the smoke nuisance have been impressed upon them with new force. Cities have come to know that the smoke nuisance is harmful and wasteful, and that smoke abatement is practicable. Cities with well-organized smoke abatement departments which have the support and interest of city administrations, cities which know the problem before them and which have planned broadly and deeply for its solution have every reason to look forward to "Noble and joyous cities, unbelievably white."

Important Points to Consider in Using Soft Coal

By C. B. THOMPSON,
President of The Thompson Heater Corporation.

Fuel economy is being forced on the American people by the constantly advancing price for all kinds of fuel. At the present time, war conditions have unsettled prices of almost every commodity, including the various fuels; but when conditions are normal, soft coal is the cheapest fuel on this continent. It occurs in almost every State and territory, while hard coal is limited to a comparatively small area of *one state only*.

The comparative prices of soft and hard coals vary for different localities. In some States soft coal sells for about half the price of hard coal. In other States the price asked for one ton of hard coal will buy three or four tons of the local soft coal.

RELATIVE HEATING VALUES OF HARD AND SOFT COAL.

The relative heating values of hard and soft coal are not well understood by the general public. The majority of the people believe that for heating purposes two and one-half to three tons of hard coal are equal to five tons of soft coal. Then again, many coal buyers are under the impression that the coal showing by analysis the highest heat content is the most valuable coal for any kind of heating purpose.

Now, in fact, neither of the foregoing suppositions is correct. Although the United States Government has analyzed a great many varieties of coal, both soft and hard, and given the same to the public through official bulletins, yet in none of those bulletins can the user find any data that will indicate the burning characteristics of soft coal.

If we are selecting a hard coal by analysis we try to get a coal with a high heat content and a low ash. But when it comes to selecting soft coals by analysis, the problem is more complicated.

BEST GRADES OF SOFT COAL LIKELY TO CAKE.

If we select for heating purposes a soft coal of the highest calorific power or heat content and low ash, we are likely to have a hard caking coal that fuses and makes into a hard mass, making the stoking a difficult and disagreeable task.

In some types of boilers this hard caking variety will be almost unburnable. The heat content of the eastern soft coal equals, and for some varieties exceeds the proximate analyses of the best hard coal. The western soft coals run from 10% to 20% lower in heat content than is found in eastern soft coals.

Notwithstanding this, the western soft coals are better adapted for burning in

down-draft and special soft coal boilers than are the eastern coals. This is so because many of the western coals are semi-caking; that is, the coal does not fuse and run together under heat as readily or bake so hard as do some of the eastern coals, and for this reason less stoking is necessary. In burning soft coal in up-draft boilers the caking coal is preferable for the reason that the coal fuses at comparatively low temperatures, forming a crust in the upper fuel mass which prevents the escape of the volatile gas. This gas is thus forced to the sides of the firepot, where it forms an intimate mixture with the oxygen, ignites and becomes useful heat.

When free-burning or semi-caking coal is burned in up-draft boilers the volatile gases which constitute from 30% to 40% of the total heat content escape through the upper strata of coal unignited and become a total heat loss.

In boilers especially designed to burn soft coals these volatile gases burn to useful heat, and for this reason a semi-caking coal is better adapted for burning in the modern soft coal boiler than are the strong caking varieties.

In selecting soft coal to burn in specially-designed soft coal boilers it is advisable to select one with a high volatile gas content, as this item indicates a free-burning or semi-caking coal. The heat content of a typical western coal will run about as follows:

Volatile matter	39.65
Fixed carbon	49.86
Ash	8.72
B.T.U. per lb.	12,000

A typical eastern soft coal will analyze about as follows:

Volatile matter	24.7
Fixed carbon	68.3
Ash	5.95
B.T.U. per lb.	14,280

The so-called smokeless coals are low in volatile matter, about 16% being a fair average, and, as is well known, these coals require a great deal of stoking because of their strong caking qualities. A very free burning coal is mined in Ohio which burns as freely as charcoal. The volatile gas content in this coal runs about 46%.

Broadly speaking, the difference in the cost of heating with soft coal as against hard coal is the difference in the cost per ton. The exceptions are for the lignite and sub-bituminous which are low in heat content.

There are many who object to using soft coal, for various reasons, but chiefly because of the smoke and soot accumulations. A properly-constructed soft coal boiler will eliminate these two objections.

WHY PEA COAL SAVES MORE THAN THE DIFFERENCE IN PRICE.

A valuable hard coal product is pea coal when burned in boilers specially constructed for same. While pea coal at the present time costs within a dollar of the price of stove coal, yet where it is burned in place of stove coal the saving is very much greater than is indicated by the difference in price. This is so because in practice *90% of fuel waste is due to burning fuel in excess of requirements.* When pea coal is burned its density prevents runaway fires, and for this reason it is an excellent draft stabilizer.

There are many instances on record where the change from stove coal burned in an up-draft boiler to pea coal burned in a specially-designed magazine boiler has effected savings as high as 40%, while the difference in price of the two sizes does not represent at the present time more than 15% or 20%.

Pea coal is easily and cleanly handled, and when burned in the right kind of boiler there is no clinker. It is too dense to burn in up-draft boilers unless mixed with a coarser coal or with broken coke.

Practical Notes on Chimneys and Draft

By W. A. PITTSFORD,
Engineer, Kewanee Boiler Company.

The accompanying illustrations and data are taken from practical notes on chimney construction and draft troubles. Referring to Fig. 1, it will be seen that there will be trouble with the draft on the building in the lower left-hand corner, when the wind currents are from certain directions, and if the surrounding conditions are such to make buildings of this character necessary, provisions must be made to overcome the downward pressure on this chimney of the lower buildings, when the wind is from the higher point.

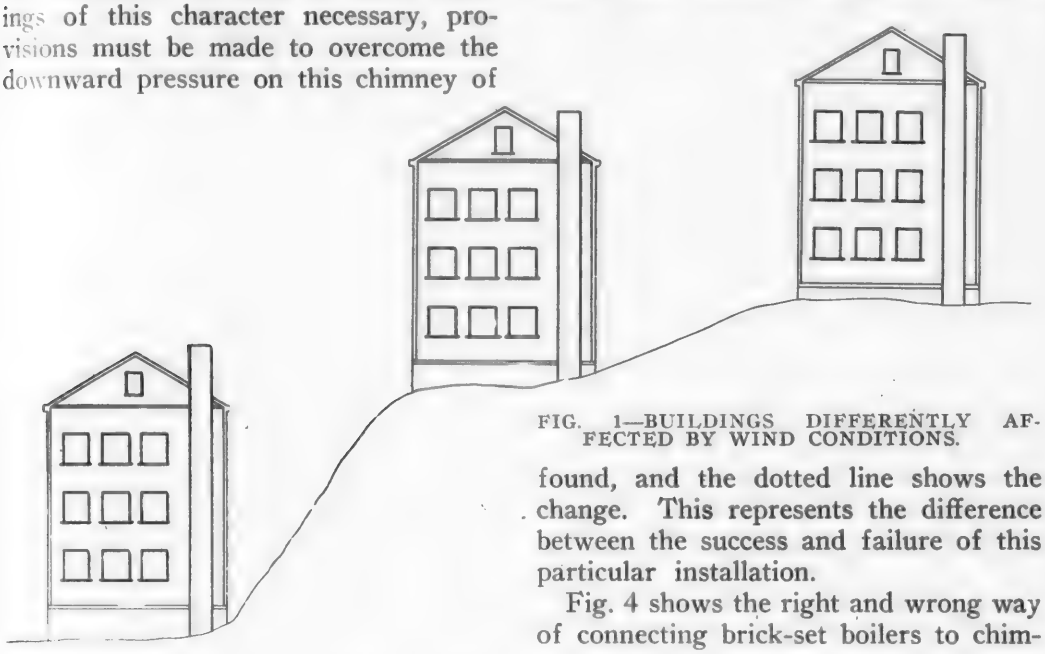


FIG. 1—BUILDINGS DIFFERENTLY AFFECTED BY WIND CONDITIONS.

Fig. 2 is a representation of a series of tests on a chimney and is very accurate, showing the velocities at different points in the chimney, which is a hexagon shape and 110 ft. high. Compared with chimneys of the same area, round or square, the difference is so slight that it is scarcely noticeable, and is shown for the purpose of recommending that if a stack has the height and area, its shape is not a feature to condemn the chimney. Of course, a round chimney is preferable in all cases, but is not absolutely necessary. However, height and area are absolutely necessary. Breechings and breeching connections are sources of more trouble than any other one thing in a heating plant. Of course, boilers that are not brick-set usually have a fixed damper opening, and are usually free from the troubles that the brick-set boiler is heir to.

Fig. 3 is a reproduction of an actual occurrence and the changes made. The heavy line shows the conditions as found, and the dotted line shows the change. This represents the difference between the success and failure of this particular installation.

Fig. 4 shows the right and wrong way of connecting brick-set boilers to chim-

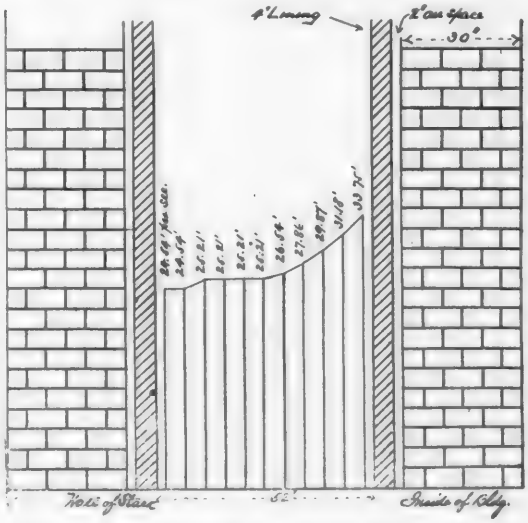


FIG 2.—RESULT OF TEST OF AIR VELOCITIES IN CHIMNEY.

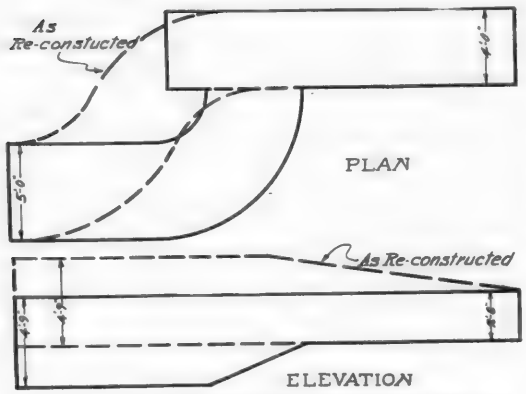


FIG. 3—CHANGES MADE IN SMOKE BREECHING TO REMEDY POOR CONDITIONS.

neys that are in the wrong place. If the chimney is such that it strikes the center line of the boiler, it should be connected to one end or the other of the boiler by curved breeching. The correct way of setting this, however, would be to either have the chimney at the front or rear of the boiler, lessening the length of breeching run. The elevation shows the kind of connection that should be at the rear or front, and in no case should it be connected with the center line of the boiler. The damper shown in the front connection on the elevation plan is wrong, because when it is wide open the opening is half closed. It should be placed at the side of the boiler shown in the plan section. If at the rear, it should be made as shown in the rear. It doesn't cost any more; is always available for doing its duty, and doesn't interfere with other boilers connected on the same run of breeching. If the breeching is carried across the top, the damper should be made as shown in the small cross section to the right of the figure. This will not interfere with the gases from any other boiler, and when open, dampers built after this manner will allow the pull of the stack to begin at the boiler, instead of meeting resistance offered by a wrong construction which reduces the size of the original opening, and prevents the stack from delivering the air to the furnace that it would or should deliver.

Fig. 5 shows the damper opening usually found in horizontal tubular boilers, and though it may have the proper area, it forms a contraction and resistance to the gases due to its shape, which should be as shown in Fig. 6.

Fig. 6 shows the opening of the damper extending the entire distance across the boiler, and allowing the free passage of the gases over more heating surface than is allowed in Fig. 5, while less resistance is offered to the flow of the gases at this point. In all settings where the free flow of gases is required, there is nothing gained by having the construction so that pockets are formed within the setting, preventing the free circulation of the gases around the heating surface. If the draft is too strong,

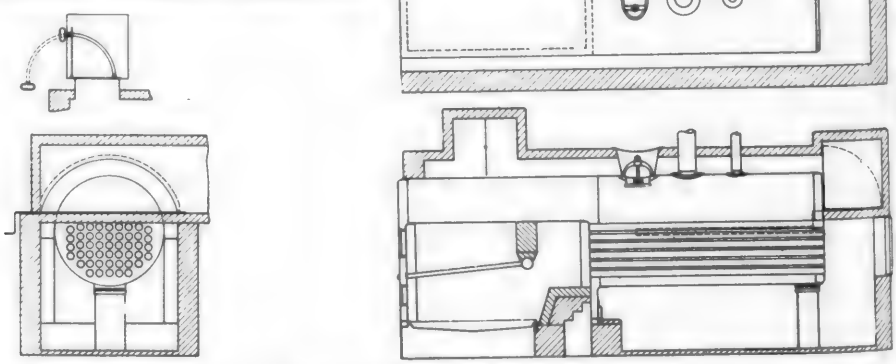
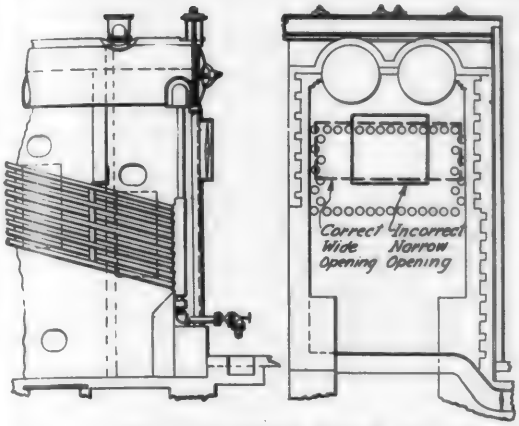


FIG. 4—RIGHT AND WRONG WAY OF CONNECTING BRICK-SET BOILERS TO CHIMNEYS IN WRONG PLACE.



FIGS. 5 AND 6—CHANGES MADE IN DAMPER OPENING IN SMOKE BREECHING TO SECURE BETTER OPERATION.

the damper can be partially closed to obtain the desired results, so that the volume of gas that the chimney will produce or the draft that it will produce is available at the damper.

Fig. 7 is a reproduction of an actual occurrence; the heavy lines showing the ordinary construction and the dotted lines showing the change on this type of boiler. It represents the difference between success and failure on this particular setting and it follows in every like construction and practical operation, where breechings are built after this manner extraordinary draft losses occur.

In Fig. 8 the design in the upper right-hand corner represents the usual construction of a breeching for low-pressure work; this construction very materially reduces the draft over the construction shown in the lower left-hand corner by eliminating three right-angle turns of the gases.

The breeching shown in the lower left-hand corner is less expensive to build and is better from every point of view,

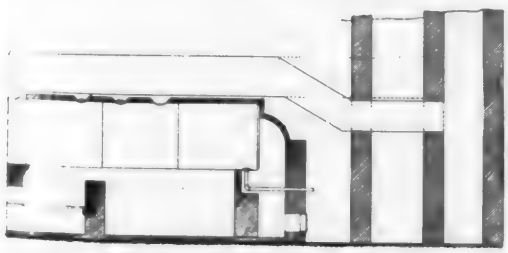


FIG. 7—ANOTHER INSTANCE OF REMEDYING CONDITIONS BY CHANGING SMOKE BREECHING.

representing the same setting, chimney being in the same place in both instances.

Fig. 9 is a chart of the actual steam consumption of 2,500 sq. ft. of radiation under mild, medium and severe weather conditions, to produce the heat necessary to heat the building. The capacity of the boiler was about 660 lbs. of steam per hour. It will be noted that it had very little to do under the mild and medium weather conditions—that is to say, that the load was quite regular, and the outside temperatures were above freezing and at freezing, while the inside temperatures were maintained at 70° F. The top curve represents a

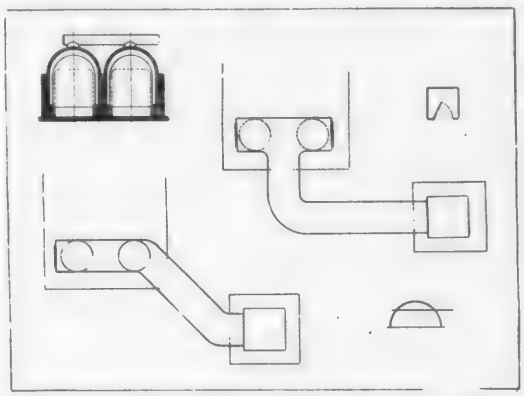


FIG. 8—TYPICAL DESIGNS OF SMOKE BREECHINGS.

severe weather condition—around 15° below zero, and shows the steam necessary to be produced to heat 2,500 sq. ft. of radiation. In this given instance, it maintained a temperature in this building of 70°. The curve showing the radiation of the boiler indicates what in average practice would be the size of the boiler for the amount of radiation.

These curves are not theoretical, but were obtained by weighing the condensation from 2,500 sq. ft. of radiation in actual use, and are used here to impress upon the mind of everyone who is dealing with this phase of engineering, the necessity of providing a draft or a chimney for the maximum load that the boiler will be called upon to produce. Every heating boiler is subject to this load fluctuation. When it is realized that the draft required to cause the flow of gas increases as the square of the velocity,

it will be seen that this is very important. For instance, if a half-inch of draft in the uptake is sufficient for satisfactory operation at one capacity, doubling the capacity at least doubles the quantity of gas, which means that the gas must flow twice as fast. Assuming that the furnace's efficiencies and temperatures were the same in both cases, theoretically, therefore, it would take four times as much draft, or 2 in. as measured by the water column, and it is for this very reason that many buildings in severe weather conditions are not heated properly.

In other words, it is the usual practice on a one-story building to build a one-story chimney, and on a two-story building to build a two-story chimney. If a three-story building, it is a three-story chimney, and so on up to the twenty-one story buildings, all of which are heating with the same relative capacity boilers, and the same efficiencies are expected in all cases (it is assumed that in all cases there is sufficient radiation to warm the building to the proper temperature under all outside conditions).

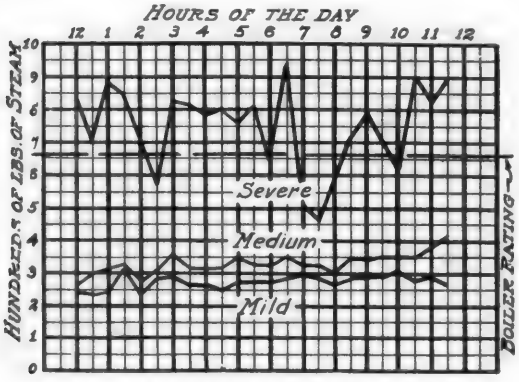


FIG. 9—RECORD OF STEAM CONSUMPTION UNDER MILD, MEDIUM AND SEVERE CONDITIONS.

No heating boiler should be connected to any chimney whose volume is sufficient, that does not produce at least 2/10-in. of draft at the damper. If there is a run of breeching from the boiler to the chimney, chimneys must be higher than where this connection is up close to the boilers. It is an extremely lame excuse to fall back on the old statement that our apartment buildings with the proper height of chimney for the proper combustion of the fuel, would look like factories. Of course, in dwellings where the prevailing apparatus is hot air or stoves, this rule should not necessarily be followed. The areas of chimneys for heating work should be in the proportion of four and one-half to one of the grate surface.

Smokeless Combustion as Applied to Single Grate Boilers

By JAMES F. McINTIRE.

Engineer for the United States Radiator Corporation.

The most noticeable effect of incomplete combustion in a boiler is the production of smoke. Smoke, however, is usually less serious from the standpoint of efficiency than the invisible effects of which the smoke is an indication. Therefore, aside from a desire to meet the smoke abatement law requirements, a boiler should be designed to prevent the loss of the invisible wasteful gases C O, free hydrogen and unburned hydrocarbons.

Chemistry of combustion proves that this loss can be eliminated if just enough air is supplied and if all the combustible in the coal is consumed, the resultant flue gas containing 21% C O.

This complete combustion is impossible in actual practice, due chiefly to the fact that the oxygen of the air can not be mixed thoroughly enough with all the combustible in the fuel.

Excess air supplied to the fuel assists in bringing oxygen in contact with the

combustible but all excess air is wasteful as it passes through the boiler to the chimney chemically unchanged, yet raised in temperature 400° F. or more.

The amount of excess air required for complete combustion can be greatly reduced by providing a means of mixing the air and combustion gases.

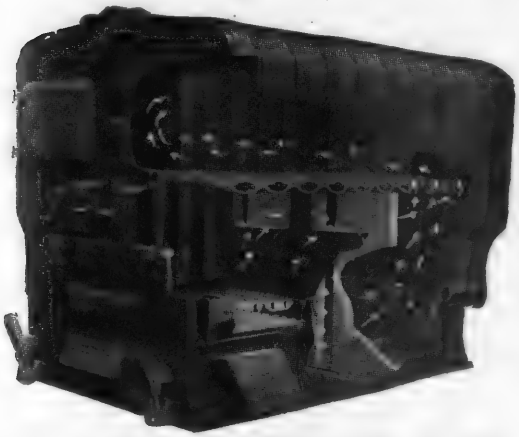


FIG. 1—TYPICAL CONSTRUCTION OF SINGLE-GRATE SMOKELESS BOILER USING COKING METHOD OF COMBUSTION.

The more complete the combustion the more smokeless the boiler operates. When combustible gases are chilled below the ignition temperature, due either to low fire-box temperatures or contact with heating surface, combustion is arrested, with smoke and poor economy as the result.

As an illustration of the points just mentioned Fig. 1 is presented to show the construction of a smokeless boiler which contains a large fire-box or furnace where bituminous coal is burned at a rapid rate of combustion. The air is admitted principally through the grates and fuel bed, with an auxiliary supply admitted at the front of the furnace, which mixes with the volatile gases distilled from the fuel bed.

These volatile gases pass from the furnace into a mixing chamber through two horizontal openings at the top and in the back of the bridge-wall of the furnace (Fig. 2). This mixing chamber back of the furnace is formed by the bridge-wall at the front and an ignition wall of fire-brick at the rear of the mixing chamber (Fig. 3). The fire-brick used in the mixing wall has a fusing temperature of 2700° F.

The temperature of the burning gases coming in contact with this ignition wall does not reach this point by several hundred degrees so that the fire-brick used in the ignition wall is practically indestructible. Because of the continuous volume of burning gases pouring from the furnace through the bridge wall and against this ignition wall it is constantly maintained at a temperature of approximately 1600° or about 400° above the ignition point, the temperature at which these gases burn.

FIG. 2—BRIDGE WALL SECTION.

FIG. 3—IGNITION WALL SECTION.

Ignition wall is used here in the sense that the fire-brick assists in igniting the combustible gases, rather than the common use of igniting green fuel.

All the gases from the furnace must pass through this mixing chamber, and while they enter the mixing chamber through two horizontal openings, Fig. 2, their escape from the mixing chamber to the combustion chamber at the rear of the boiler is through a long vertical opening in the ignition wall, Fig. 3, the area of which is slightly less than the area of the two horizontal openings into the mixing chamber. The effect of this arrangement is a congestion and intermixture of burning gases within the mixing chamber in contact constantly with the ignition wall, which is maintained at a temperature above the ignition point of the gases.

The combustion of these gases is completed in the combustion chamber at the rear of the boiler where the temperature is but slightly lower than that of the mixing chamber and well above the burning point of these gases. From the combustion chamber the gases are rapidly cooled in the large flues, passing to the front of the boiler on each side, Fig. 1, from which point they are returned to the smoke-hood through the inner flues of equal area.

The use of this mixing chamber, with its ignition wall, and the combustion chamber, is intended to completely burn the volatile matter in the fuel before the gases are cooled below their burning point, and thus fulfill the requirements for smokeless combustion.

As the volatile matter of the coal is completely burned in the boiler there is no smoke to escape to the open air except during the time when the fire doors are open and the coal is being fed to the boiler.

The Sales Engineer

By F. R. STILL.

(From a paper read at a recent meeting of the Michigan Chapter, A. S. H. & V. E.)

Most large institutions now employ an operating staff of engineers bearing, at least, the following titles, and some concerns have many others in addition, viz.: consulting engineer, construction engineer, engineers of tools and equipment, electrical, power plant, chemical, metallurgical, production, planning, scheduling, efficiency, costs, estimating, transportation, service, inspection, employment, welfare and sales.

There is hardly any other branch of engineering where such a direct measure of a man's efficiency can be obtained by the manager as in sales engineering. The sales engineer comes before him every day in one form or another. Maybe it is through orders, reports of sales, expense accounts, collections, some clause in a contract, service, engineering; but, be it what it may, it keeps him constantly before the manager and the principal heads of departments and he is being mentally measured day by day by every one of them.

Exceptionally good men are scarce; none of them are ever overlooked; mediocre men always think they are, and some of them are overlooked. I may even go so far as to say that some of them are purposely overlooked.

The qualifications of a first class sales engineer may be properly divided into five heads, entitled educational, practical, business, social and moral.

EDUCATIONAL TRAINING.

Practically every concern now employs graduates from engineering colleges or schools to the exclusion of all others, for any branch of engineering work. A few break into the sales work who have come up from the ranks, but not many.

In addition to a thorough grounding in general engineering, a student who contemplates sales work must study commercial law, insofar as it concerns building construction, land titles, liens, bankruptcy, receivership, corporation acts, contracts, bonds and commercial paper.

He must have a good command of lan-

guage, know how to give expression to his thoughts, be able to write good, clear, definite and convincing letters.

His engineering knowledge must be so broad that he can discuss with and advise any customer, whether such be an architect, or engineer of high standing, on matters entirely outside his own particular specialty, because the impression gained by the customer from the knowledge he exhibits of those things which his customer knows all about, immediately establishes the confidence the customer feels he can place upon the advice given him in those things about which he knows little or nothing.

PRACTICAL TRAINING.

This, of course, covers experiences, more or less prolonged, in every branch of his line of both engineering and business. It includes machine design, planning and all the other branches of drafting-room work; experience in all the various departments of the office and shop; outside construction work; estimating; correcting difficulties with customers; making installations work right, etc. Here he gets his hard knocks and learns more of real value than he realizes until later on. It is here where many of the students break down. They do not understand why they should put in months at this sort of thing after spending four years at college. Those who stick it out are always glad they did, long after it is over.

BUSINESS TRAINING.

Business training can only be gained by actually doing business with people. Certain things can be learned from books and lectures but the everyday meeting and dealing with people is the final course.

One can learn by study how to draw up specifications, contracts, keep a set of books, draw up all kinds of legal forms, learn how to determine the amount of credit to extend to an individual, what kind of terms to allow, how to figure costs, overhead and profit on various kinds of work, but it takes business sagacity coupled with real business experience to avoid the many traps and pitfalls laid for a salesman.

SOCIAL TRAINING.

Most corporations look quite carefully into the home life and surroundings of every young man for this class of work. It is necessary, as he is to be the personal representative of the company and he must be fit to associate with anybody. He must naturally be a "good mixer" and know how to wear a "Billy Baxter front."

He must cultivate a taste for clean sport and be able to take a hand at most of the outdoor and indoor games which form the pastimes of business men.

He must be pleasant and agreeable without making his presence offensively noticeable in trying to attain such a demeanor. It must be natural.

The value of various clubs, societies and fraternal organizations in business affairs is questionable; to the average man it is repulsive when anybody tries to work such a connection as a leverage to get attention or special consideration. Most men will go out of their way to turn down such a fellow.

Belonging to some such organizations is helpful in broadening acquaintanceship and frequently does lead to greater familiarity than might be possible in any other manner; membership in such societies sometimes makes it convenient to approach a man on business matters, whereas it might be extremely difficult to get at him in any other way.

MORAL TRAINING.

Family history, home training and temperament count more in the "moral character" of every young man than anything else, assuming he has been brought up in the proper home surroundings. A man cannot be a real gentleman, unless instinctively so inclined.

Clean habits, truthfulness, the temperate use of intoxicants, no gambling instincts and respect for the rights of others, are the cardinal points for consideration in measuring up the moral character of any young man.

FINALLY.

As time goes one, the competition for the higher positions becomes fiercer; not only is it harder for the young man to get started in desirable places, but it is also becoming harder for the old heads to hold on to their positions. The changes which take place in some institutions are swift and surprising. It is a race for supremacy by merit and is only won by the best equipped.

In sales engineering work a man has no chance for demotion; it is a case with him of going higher or getting out. If his salary and expenses exceed a certain percentage of his sales, he is a doomed man in most instances.

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IN PREPARING the matter appearing in this issue on the smokeless combustion of coal it was impossible not to realize the fact that a strange combination of circumstances has raised the smokeless boiler to a place of pre-eminence in the development of the art of heating, at the same time making a discussion of this subject one of the most timely that could be brought before our readers. While for the past twenty years various cities in the United States located in what are known as the soft coal regions have been battling with the smoke nuisance, the campaign attracted but little attention in other localities that were not put to the necessity of using soft coal.

This was the situation when the European War brought home the fact that the price of coal was not a stable proposition after all and that a situation might easily arise that would make it necessary to substitute cheaper grades of coal for the expensive grades that such sections as the East had always been accustomed to. In recent months this situation has developed rapidly. Not only has the price of coal soared to unheard-of heights, but, as central heating plant managers so well know, coal became difficult to obtain at any price. At this critical juncture came the regulation by the government of both wholesale and retail coal prices. While the government's action served to clarify the situation, in a way, it left no doubt in the mind of anyone that high coal prices have come to stay. That is to say, we are at the threshold of a new coal era both for heating and power plants in which the smaller sizes of anthracite and soft coal are to have the call.

With this situation clearly understood it is a matter of the utmost interest to the heating engineer to know that American ingenuity has developed numerous types of apparatus in which bituminous coal can be successfully used, practically without smoke, and with an adaptability ranging from small residence work to that of apartment houses and other large buildings. That the manufacturers have been quick to realize this is evidenced by the unusual number of announcements of their product appearing this month in our advertising columns. Incidentally it is a matter of gratification to state that this is the second largest number of THE HEATING AND VENTILATING MAGAZINE we have ever issued, and the largest in point of advertising patronage. It is also proper to state that the editorial management of our second annual Smokeless Boiler Number has been in the hands of Martin A. Rooney, formerly smoke inspector of Nashville, Tenn., whose wide experience and knowledge of smoke abatement work is reflected in the character and scope of this month's contents.

Novel Method for Obtaining Height of Chimney

A novel method for obtaining the height of a chimney was described in a recent number of the Ideal Heating Journal, the periodical of the American Radiator Company. Two indirect methods were shown which are reproduced herewith. Following are the directions: Take an extension rule so arranged that two sections of the rule are at right angles to two other sections of equal length, as shown in the sketch, Figure A. Place the eye at the end of the long arm and move away from the chimney until the top and bottom of the chimney are in line with the top and bottom points of the short arms of the extension rule. Care should be exercised in having the eye close to the end of the rule. When the points suggested above are in alignment, measure the distance from your position to the base of the chimney. This distance will give the height of this stack. It is, of course, necessary to measure this distance on level ground. To the distance thus obtained, add the distance from the ground to the basement floor. In place of the extension rule there may be used two sticks of equal length, approximately 2 ft. long, with one stick fastened in the middle at right angles to the end of the other. The second suggestion, Figure B, is to obtain a pan and fill with water, placing the pan on the ground at a distance from the chimney. Then move back until the reflection of the top of the chimney appears in the water. Measure the distance you are standing from the pan, also the distance from the pan to the base of the chimney, and the distance from the ground to the observer's eye. The height of the chimney may then be determined as follows: Multiply the distance in feet from the pan to the chimney by the distance in feet from the ground to the eye of the observer and divide this product by the distance in feet from the observer to the pan. The result will give the required height from ground to top of chimney. To this distance should be added, as in the first case, the distance from the ground to the basement floor. A looking glass may be used in place of the pan of water.

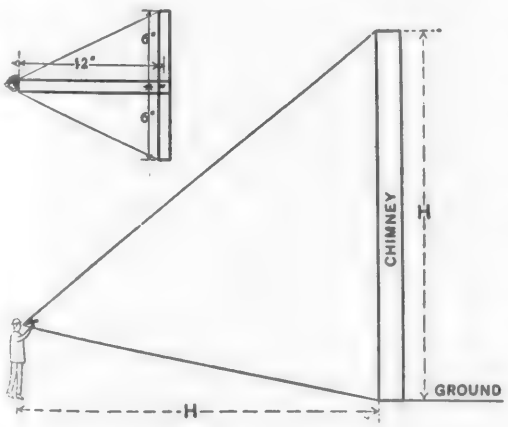


FIG. A.

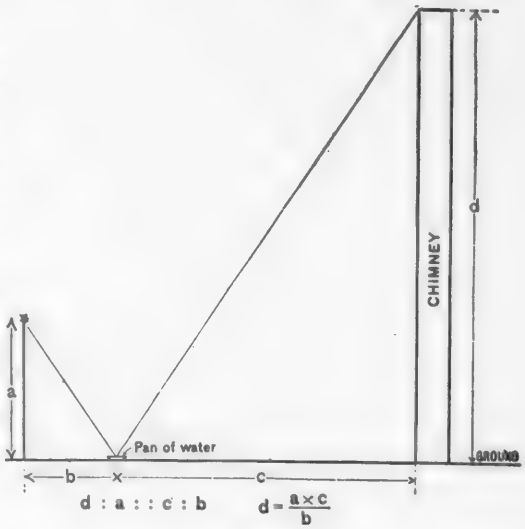


FIG. B.

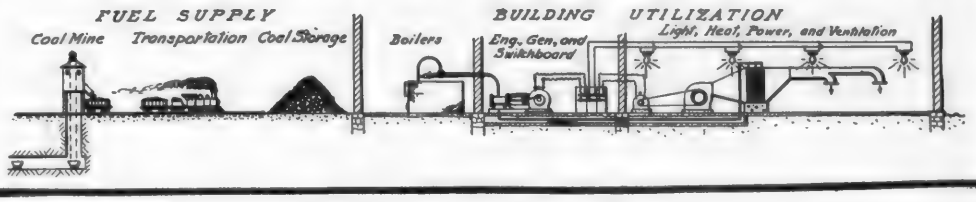
Twelfth Annual Convention of Smoke Prevention Association.

Among the papers read at the twelfth annual convention of the Smoke Prevention Association, held in Columbus, O., September 25-27, was one by Henry Misostow on "Proportioning a Chimney on a Fuel Basis," and one by W. C. Ross on "The Manufacture of By-Product Coke and Its Effect on the Domestic Smoke Problem." A report was presented of the government tests held at the Bureau of Mines in Pittsburgh and there was also a topical discussion of the subject of powdered coal. One day's session was given over to smoke abatement in relation to locomotives.

L. H. Reed, of Chicago, was re-elected president of the association; Daniel Maloney, of New York, was elected first vice-president; J. T. Corbett, Michigan City, Mich., second vice-president; and Frank A. Chambers, Chicago, secretary and treasurer.

Newark, N. J., was chosen as the next convention city.

POWER PLANT ENGINEERING



Notes on Boiler Feeding

When a boiler or battery of boilers is operated at a steam pressure higher than that carried in the heating system it is impossible to return the condensation by gravity; with an open feed-water heater it is also impossible to have any pressure on the feed water over 5 lbs. gauge because the heater—in utilizing the exhaust steam from the engines—must, at the same time, keep the back pressure down to as low a point as possible. Therefore, some means of forcing water into the boiler against the boiler pressure must be supplied.

For this reason in every power plant boiler-feed devices are installed for the purpose of replacing the water in the boilers as fast as it is evaporated into steam. Usually these devices provide for the supplying of *hot* feed-water, as the economy of heating feed-water is now fully recognized and the advantage of saving temperature strains on the boiler, by having the feed-water as near the boiler temperature as possible, is self-evident.

THREE GENERAL TYPES OF BOILER-FEED PUMPS.

The most common method of boiler feeding is by means of boiler-feed pumps of which there are an infinite number of varieties. All feed-pumps, however, may be classified into three general types according to their method of operation, *viz.:*

(*a*) Piston and plunger pumps.
(*b*) Rotary and screw pumps.
(*c*) Centrifugal pumps.
(*d*) Jet pumps.

Piston and plunger pumps—which are by far the most common type of boiler feed pump used for building power-plants—consist of two cylinders in one of which steam operates a piston, connected by a piston rod, to the piston or plunger in the water cylinder, thus moving the water and resulting in pumping when properly arranged and valved.

These pumps, when consisting of one water cylinder, are termed *"simple"* pumps and give a pulsating discharge which is overcome to some extent by mounting two pumps together and operating the steam ends, so that one pump is in the middle of its stroke when the other is at the end. Such pumps are termed *"duplex"* pumps and are much perferable to the simple pump. Practically all boiler-feed pumps are built double-acting—that is, the piston or plunger moving toward one end of the cylinder is not only forcing the water along ahead of it but is also drawing water into the cylinder behind, ready to be pumped out on the reverse stroke.

A piston pump is not regarded by some as highly as a plunger pump, the water between the piston and cylinder being much harder to take care of than if a plunger and bushing are used; "outside packed" pumps are more easily repaired than those with inside packing.

To illustrate clearly the difference between the piston and plunger type of pumps Figs. 1 and 2 are shown. In Fig. 1 the piston arrangement is given, the piston operating within a cylinder in the same manner as the steam piston in the steam cylinder at the opposite end of the pump. The piston moving back and forth inside the cylinder, draws the water from the suction chamber up through the lower set of valves into the pump chamber; on the reverse movement the water is driven out of the pump chamber and up into the discharge chamber through the upper set of valves. Wear in the cylinder can only be taken care of by means of reboring.

In Fig. 2 the plunger arrangement is indicated, the plunger moving back and forth inside of the bushing shown; the cycle of operation is similar to the piston pump but the location of valves and chambers is slightly changed. The steam consumption of these pumps runs from 60 to 120 lbs. per H. P. but, as the exhaust is used in the heating system and as the pump H. P.

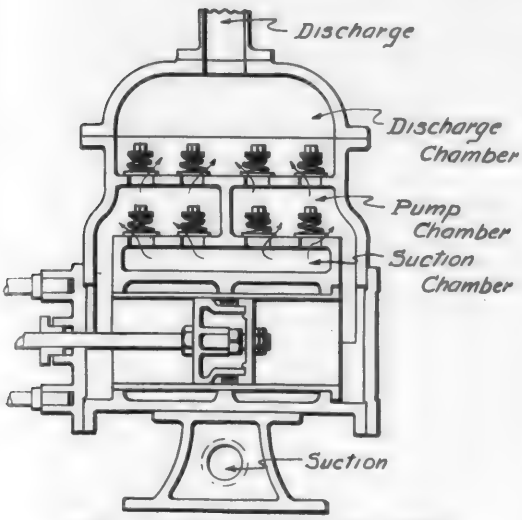


FIG. 1—PISTON TYPE OF PUMP.

is a relatively small amount, this is not a serious matter.

HOW TO FIGURE DISCHARGE FROM "SIMPLE" PUMP.

On piston and plunger pumps the piston speed should never exceed 100 ft. per minute or 60 double strokes so that the discharge from any "simple" pump is obtained by the following formula:

$100\ A \times 7.5 + S =$ gallons per minute delivered.

When A = Area of water cylinder in square feet

100 = Piston speed in feet per minute

7.5 = Gallons per cubic foot

S = Slippage—usually 10% to 15% in ordinary pumps

Thus, for 12,000 gallons per hour

$$100\ A \times 7.5 = \frac{12000}{60} + 10\% \text{ of } \frac{12000}{60}$$

$$A = \frac{200 + 20}{100 \times 7.5}$$

$$A = \frac{220}{750}$$

$$A = 0.293 \text{ sq. ft.}$$

Diameter = 0.61 ft. or 8 in. diameter.

For a "duplex" pump the area of each cylinder would be just one-half or

$$\frac{0.293}{2} = 0.146 \text{ sq. ft.}$$

Diameter = 0.43 ft. or 5⅛ in. Probably a 5-in. cylinder would be used.

Air chambers are recommended on all piston pumps to absorb the shock of discharge and provision would be made for renewing the air supply as fast as it is carried away by the water. One large power producing corporation has all their air cylinders tapped and gauge glasses installed so that the quantity of air is visible to the engineer at all times. The volume of the air chamber on single pumps should be equal to three or four times the volume of the water cylinder, but on "duplex", one-half to one-third the volume of the water cylinder is sufficient.

To check the size of the steam cylinder, the operating steam pressure must be known and the total head against which the pump is operating, including both suction and discharge. It is not usually customary to have a boiler-feed pump, which is handling hot feed-water, do any lifting on the suction side so that the discharge pressure only need be considered. With 100 lbs. of boiler pressure the pump must discharge against the boiler pressure plus the pipe friction between the pump and the boilers.

If 10 lbs. friction in the pipe line is allowed the total pressure against which the pump operates will be 100 lbs. + 10 lbs. = 110 lbs. per square inch. But the pump also has internal friction within itself for which it is customary to allow about 25%. Then if the water cylinder is 8 in. in diameter the total load on the piston will be

$50.26 \times 110 \times 125\%$ or

50.26×137.5, or 6911 lbs.

To counterbalance this on the steam end

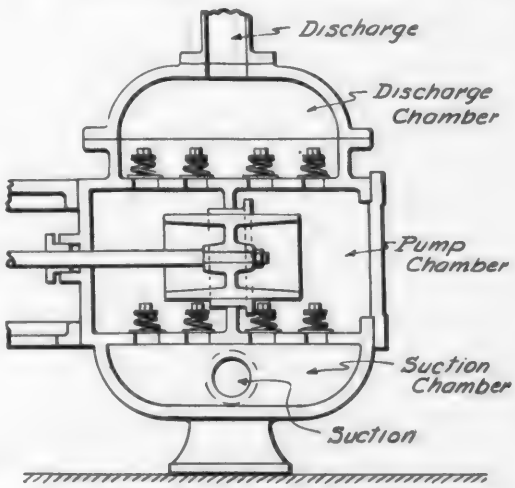


FIG. 2—PLUNGER TYPE OF PUMP.

the area of the steam cylinder must be not less than

6911 ÷ 100 = 69.1 sq. in or 9½ in.

With a duplex pump it would be 19.63 × 110 × 125%, or 2699 lbs.

2699 ÷ 100 = 27 sq. in., or 6-in. cylinder.

The length of stroke is obtained as follows:

Piston Speed = 100 f.p.m.

Maximum number of double strokes = 60.

Total number of single strokes = 60 × 2, or 120.

100 ft. movement ÷ 120 single strokes = 0.83 ft. per stroke, or 5/6×12=10 in. stroke.

Therefore the size pump required would be a

9½ in. × 8 in. × 10 in. single, or a

6 in. × 5 in. × 10 in. duplex.

The reader, of course, is aware that in designating a steam pump the first figure is the diameter of the steam cylinder, the second figure the diameter of the water cylinder and the last figure the stroke-all in inches.

As a basis for figuring the gallons per minute required, the maximum number of pounds of steam made per hour is divided by 8⅓. Where the boiler horsepower is used as a basis the nominal rating must not be used but instead the actual boiler horsepower produced. Thus, for 200 H.P. boilers run at 25% overload the actual B.H.P. produced is 200 × 1.25 = 250 H.P.

250 × 30 lbs. of water = 7500 lbs. of water per hour.

7500 ÷ 8⅓ = 900 gal. of water per hour.

which should be increased slightly for safety, calling it, say, 1000 g.p.h.

Good practice demands the installation on small plants of two pumps each of 100% capacity, either of which can feed all the boilers when carrying their maximum load. On larger plants three pumps are sometimes used each of 50% capacity so that any two can supply the boilers, with the third as a spare pump.

In cases of economy a pump used for another purpose is sometimes depended upon as a spare pump in case of emergency. For instance, a hot water circulating pump made of the same type and capacity as the boiler-feed pumps might—by proper cross-connecting—be made to save the installation of another spare pump.

A three-cylinder pump is termed a *"triplex"* pump, but is so seldom used for boiler feed that it may be ignored in this discussion.

ROTARY AND SCREW PUMPS.

The second classification of pumps, *viz.:* rotary and screw pumps—is but little used for power plants. These pumps operate by the interlocking of lobes or screw threads between two parallel shafts, combined with the movement of the lobes or screw threads against the casing. The travelling of the lobes or the threads along the casing transports water from the suction to the discharge side while its return is prevented by the interlocking of the

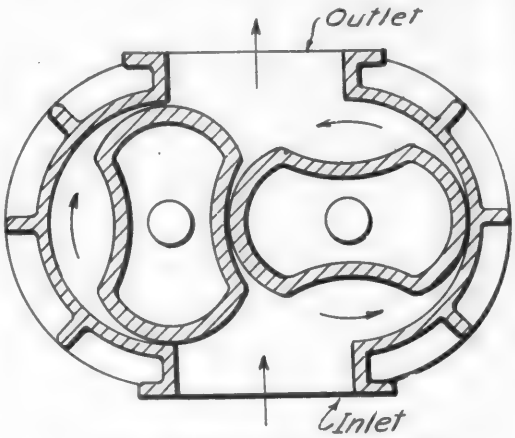


FIG. 3—TYPICAL ROTARY PUMP.

lobes or threads in the middle. A rotary pump is illustrated in Fig. 3 and it is self-evident that it would be impossible to accommodate wear in such an arrangement, this indeed being the greatest objection to this type. Their use is more common for fire service where short service and positive action are the main features of their operation.

CENTRIFUGAL PUMPS.

The third classification of pumps includes all centrifugal pumps in which the water builds up a pressure against the outside casing from its centrifugal force caused by being rapidly rotated by an interior propeller. The action is largely similar to that attained in the centrifugal fan familiar to all our readers. To balance the pressure the suction water is often admitted to the center of the casing from both sides and discharge taken from the side of the casing, as shown in Fig. 4. These pumps are not particularly efficient, the efficiency hovering around 50% to 60% and falling off rapidly at high pressures; when used for boiler-feed purposes they are compounded into two-stage or three-stage pumps, each stage being virtually a complete centrifugal pump in which the water enters the suction at the pressure discharged from the previous stage and is boosted up in pressure by the addition of the centrifugal pressure created by the stage in question. Each stage is usually considered as raising 40 to 50 lbs. pressure; thus a pump operating against 35 lbs. would be a single-stage,

against 80 lbs., a two-stage and against 125 lbs. a three-stage pump. All centrifugal pumps must be belt, motor or steam turbine driven, owing to their high speeds.

The amount of slip which may be expected in centrifugal pumps expressed in percentage of the theoretical volume pumped is as follows:

Small size: at low speed 60% at high speed 75%.

Medium size: at low speed 40% at high speed 50%.

Large size: at low speed 15% at high speed 25%.

JET PUMPS.

The jet pump, when used for boiler-feed work consists of a device that is commonly termed an "injector" and its principle of operation seems to introduce a real mechanical paradox. How a jet of steam which must be fed from a source of steam supply at a pressure somewhat lower than the boiler (due to the pipe friction) can attain a velocity sufficient to again re-enter the boiler against the

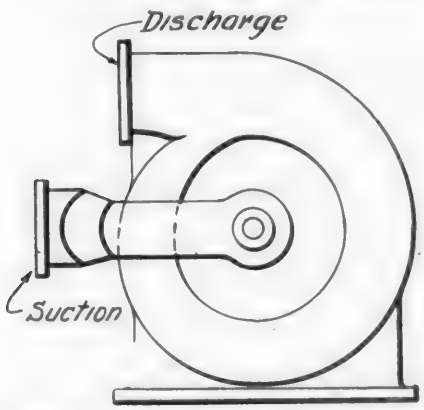


FIG. 4—TYPICAL FORM OF CENTRIFUGAL PUMP.

higher pressure seems peculiar; that it can not only insert itself but at the same time can carry sufficient water with it to serve as a feed for the boiler is very remarkable, and the fact that it can lift this water a considerable distance by suction in order to accomplish its work seems impossible.

The most simple form of injector is illustrated in Fig. 5 where opening the steam valve in the steam line will cause steam to flow at a high velocity through the interior nozzle and into the pipe leading to the boiler. In order to start the lifting of water through the suction line a cold water line is connected in at the top so as to allow the condensing of the steam jet after it has started, thus producing a vacuum and drawing up the water in the suction pipe, after which the water valve is closed. If the suction pipe is furnished with water under sufficient head to cause it to flow into the boiler pipe without requiring suction the water pipe may be omitted.

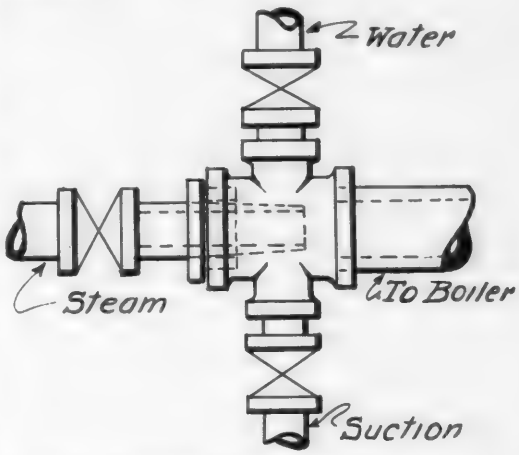


FIG. 5—SIMPLE FORM OF INJECTOR.

The thermal efficiency of an injector is almost 100% as practically all the heat in the steam is again returned to the boiler, but it will not handle hot feed-water and therein lies its objection. The injector principle has been developed along various lines by manufacturers and there are many good and reliable makes on the market; the use of the injector in the building power plant is limited to emergency cases only. In some instances they are installed in place of a spare boiler-feed pump, resulting in quite a saving on the initial expense for pumps.

Notes

It is claimed that 63% of New York's 154 largest buildings, representing 78% of the total valuation, have independent power plants. The buildings listed in classes show that of the

Railroad Stations	100%	have power plants
Hotels	96%	
Offices and Stores	72%	
Banks	57%	
Clubs	57%	
Apartments	37%	
Theatres	0%	

In Philadelphia for a given section, out of 192 buildings, 137 have power plants.

In these days of the high cost of brass strict watch should be maintained of articles

furnished under specifications calling for brass. Some unscrupulous manufacturers are turning out iron or steel parts and having them brass plated, giving them every outward appearance of the genuine article. A small magnet carried in the pocket will enable one to detect such substitution, as the magnet will cling to any object containing iron or steel.

CORRESPONDENCE

Removing Oil from Radiators.

EDITOR HEATING AND VENTILATING MAGAZINE:

I have a large amount of radiation on a forced hot water system which has grown quite inefficient due to oil getting into the system from the fuel oil lines. Please inform me the best way to clean the oil from the inside of cast-iron radiation. Turning high-pressure steam and boiling water into the radiation will likely wash it out, but will it remove the oil film? Could you suggest any acid or lye bath or any practical method of cutting the oil out? Also, can you offer any suggestions as to making a permanent washing apparatus for radiators?

L. L. B.

Bremerton, Wash.

Oil is not a new factor to be encountered in steam heating systems and its existence therein results in numerous troubles such as a fluctuating water-line in the boilers, water in the steam lines, water hammer, and loss of efficiency in the radiating surface. Oil is hardly ever encountered, however, in any but new systems and in this respect our correspondent's complaint is very unusual; how fuel oil could enter a hot water heating system against the static head of the water contained therein, is not very easy to conceive but assuming that the oil has entered the system the thing is to get rid of it as thoroughly as possible and in the quickest practical manner.

For this we would recommend the well-known soda treatment which (on a steam system) consists of adding about 5 lbs. of common washing soda to the boiler water and boiling slowly for an hour, then blowing off the entire charge and refilling with cold water; this second charge is filled up higher than the proper water line so as to thoroughly wash out the interior of the boiler and, after boiling for a short interval, is also blown off. Then the boiler is refilled a second time and is ready for use. This process is repeated whenever the oil coming back from the piping system collects in sufficient quantity to become troublesome.

In the case under consideration, owing to its being a hot-water system with "a large amount of radiation," it is probable that 15 or 20 lbs. of soda would have to be used in order to produce a solution of the required strength with such a large volume of water. This soda dissolved in water and injected into the system can be circulated through the pipes and radiators by the circulation pump, then the system emptied, refilled and washed out, and then refilled a second time the same as for a steam boiler.

Owing to its being impossible to "boil out" the system with the soda solution the results may not be wholly satisfactory and, if an examination after the soda treatment shows the oil still present, lye or potash should be used as a final remedy. It is not necessary to use as much lye as soda, probably about 5 lbs. will be sufficient to remove the oil; the action of the lye when coming into contact with grease or oil is to cut the grease so as to make it dissolvable in water, a familiar example of this being found in common soap; the grease after dissolving in the water and forming a soapy solution is carried out of the system when the water is changed.

We do not know of any way of "making a permanent washing apparatus for radiators," if by this is meant a method of continuously cleaning them of oil. In a hot-water system the oil would be likely to seek the highest parts of the system, collecting there due to its lighter specific gravity, and a blowoff or overflow from such points might remove the major part of the trouble; it would not, however, prevent the oil forming a film on the interior of the piping and radiators which is the greatest source of trouble here.

We do not believe that high pressure steam or hot boiling water would be of any use in removing the oil but, on the contrary, might burst the radiators due to the excessive pressure.

Are Two Smaller Boilers as Efficient as One Large Boiler, the Capacities Being Equal?

EDITOR HEATING AND VENTILATING MAGAZINE:

I would appreciate your opinion on the following much discussed question:

Which is the more efficient, one larger cast-iron sectional boiler for a low-pressure

heating job, or two smaller boilers having a combined rating equal to the one large boiler?

To be specific, I have a building containing 7,000 sq. ft. of direct radiation. The boiler I have in mind to use is one with a rating of 12,000 sq. ft. and a grate surface of about 26 sq. ft. This can be installed at a saving of about $800.00 over a two-boiler plant, the two boilers each have a rating of 6,000 sq. ft. and a grate area of about 23 sq. ft. each.

Would the saving made in increased efficiency (if any) of the two-boiler plant over the one boiler, make up in a reasonable time the added initial cost of the two-boiler plant?

What merit is there in the large boiler manufacturers' claim that their relatively smaller, shorter grate permits a relatively longer flow of hot gases over the heating surface, this sending cooler gases out through the smoke stack, and that a thicker fire may be carried, thus lessening the amount of attention to coaling? J. C. L.

Indianapolis, Ind.

We unhesitatingly recommend the use of two boilers for a heating plant of this size, the advantages of two smaller boilers over a single large boiler consisting of the following:

(*a*) A more dependable heating plant as a breakdown in one unit would allow the entire building to be operated on the other in ordinary weather and the more important portions even in extreme weather.

(*b*) The use of a smaller unit run at a more active rate of combustion during all ordinary weather. This means a smaller radiation loss than if a boiler twice as large were used and the higher rate of combustion will give a greater evaporation per pound of coal burned, due to the increased radiant heat and therefore a greater efficiency.

(*c*) It is easier to run a smaller boiler fire at a fairly active rate of combustion than it is to run a fire twice as large at only one-half the rate of combustion.

(*d*) It is usually possible to hold a much more even steam pressure with two boilers by firing alternately so that one fire is coming up at the time the other is going down.

(*e*) The coal charge for two boilers is usually much larger than for one boiler of double the capacity because it is customary in the trade to figure a lower rate of combustion on smaller boilers. This is particularly noticeable on the two propositions under consideration where the single 12,000 sq. ft. boiler has a grate surface of 26 sq. ft. and the two 6,000 sq. ft. boilers have a combined grate area of 46 sq. ft. To develop full boiler rating at an efficiency of 8,000 B.T.U. per pound of coal and 250 B.T.U. per square foot of radation this means

$$\frac{12000 \times 250}{8000 \times 26} = 14.4 \text{ lbs. per square foot of grate for the larger boiler.}$$

$$\frac{6000 \times 250}{8000 \times 23} = 8.2 \text{ lbs. per square foot of grate for the smaller boilers.}$$

We believe that the larger boiler is overrated as the combustion rate of 14 or 15 lbs. of coal per square foot of grate is entirely too high for ordinary natural draft conditions and it could never be reached in actual practice except under very unusual circumstances. With a good chimney 8 lbs. per square foot on the two smaller boilers in extreme weather is perfectly practical or at least much more so than 14 or 15 lbs. under the same conditions.

For the case under discussion we would recommend two boilers each of 60% capacity allowing 25% for radiation on the mains. Thus:

7000 + 25% of 7000 = 7000 + 1750 = 8750 total square feet of radiation.

At 250 B.T.U. per square foot 8750 × 250 = 2,187,500 B.T.U.

At 8000 B.T.U. per pound of coal, 2,187,500/8000 = 273 lbs. per hour.

At 10 lbs. per square foot of grate = 273/10 = 27.3 grate area for two boilers or 27.3 × 60% = 16.4 sq. ft. per boiler.

If the grate area is proportional to the smaller 6,000 sq. ft. boilers this would make the rating on the smaller boilers

6000 : × : 23 : 16.4.

$$\frac{6000}{23} \times 16.4 = \quad \times \text{ or } 4275 \text{ sq. ft. rating,}$$

instead of 6,000.

This will cut out some of the $800.00 additional cost of the two 6,000 sq. ft. boilers.

We also believe that the saving would, in a reasonable length of time, reimburse the owner for the added cost of installation, to say nothing of the increased convenience of operation.

In regard to the last part of the inquiry we do not attach a great deal of importance to the factor of grate length and its bearing on boiler efficiency. While the temperature of the gases in the stack might be

higher—as would be the case if a boiler were being run as hard as possible—still the added radiant heat more than offsets the small increase in stack losses. Boilers with proper heating surface when tested have shown an evaporation of 8.96 lbs. of water when run at a 9-lb. combustion rate and 9.47 lbs. of water when run at a 24-lb. combustion rate, thus indicating greater efficiencies under forcing and, therefore, under higher stack temperatures.

Evolution in the Art of Heating, as Seen by an Old-Timer.

EDITOR HEATING AND VENTILATING MAGAZINE:

Your editorial in the August issue has struck a very responsive chord up at my little hole in the wall. My record of 64 years' service enrolls me automatically as one of the "Old Guard,"—13 years at the trade, 17 years as a contractor and 34 years specializing, principally in very low pressure steam heating and, finally, in vacuum principles. It strikes me that the "Old Guard," like the G. A. R., are fast becoming a dissolving view, and I believe I voice the feelings of the remaining few when I say that our successors do not avail themselves of our experiences to the extent that we are willing they should do.

In all arts alike unless the younger set begins where the older men left off, a regular tread-wheel process results, each man starting back nearly at the beginning, thus rendering both progress and evolution difficult. Perhaps I can not better illustrate this than by taking the inspiration of your reference to vapor heating systems and enlarging upon it to the extent of stating a few interesting facts.

Vapor systems were brought to great perfection (for the times) in France by a man named Debessant, a hundred years ago. In 1883 I visited New York especially to inspect a heating plant in the Metropolitan Opera House, erected upon a contract given to Frank Tudor—*carte blanche*. In the 34 years elapsing I have seen no promotions or suggestions or erections of any vapor heating system that in any way compares with that in the opera house. I question very much if any of the promoters of vapor systems would assume the responsibility of placing a vapor system on a job of that size and importance, even to-day. The Tudor fractional valve, in finish and function, has not been excelled by any later-day device.

Suggested by conditions that were favorable, in 1883 or a year later than the Williams patent date, I erected my first vacuum heating system. It seems interesting that in March, 1897, or just 14 years later. I assumed the responsibilities of the Webster heating department, in a patent-protected business. Under purely physical conditions, the limitations of vacuum heating systems were reached by myself in a prospect for the Kodak Company, in Rochester, where no vacuum could be secured at the remote positions. I designed and patented a special functional device to meet such requirements and later, in an extension of the same plant, I easily carried steam at atmosphere 3,000 ft., a longer distance than could be effected by a regular vacuum system even if 30-in. of vacuum were maintained. The dates of these developments were 1902 and 1906.

In my opinion engineers are actually derelict in not having an experimental bureau, liberally endowed to enable them to test and thresh out the wheat from the stubble, and drive out of the market defective materials and systems. I am intensely interested in the younger and less experienced men in the profession. As my entrance into the art dates from a period when gravity returns were not thought of, and when the returns were discharged to the sewer through a cracked valve, and afterwards at that point a trap was installed, it will indicate I have traveled an uncharted sea, the shoals and perils of which I would gladly prevent my successors from experiencing.

C. A. BALL.

New York.

Reminiscences of an Engineer.

EDITOR HEATING AND VENTILATING MAGAZINE:

In connection with the article by the writer which was published in THE HEATING AND VENTILATING MAGAZINE for September, on the subject of "Reminiscenes of an Engineer," the illustration entitled "Cross-section of the Merrimac Type of Ram in Civil War Days," should have read "Cross-section of the type of monitors which engaged the Merrimac."

The Merrimac had a pitched roof over her main deck, very much like the pitched roof of an ordinary barn, with dormer windows cut into it, as port-holes for her guns. The roof was armored and protected with old railroad rails arranged alternately, one up and one down so as to interlock. If furnished a protection above her guns on about an angle of 45°, making an iron armor about 4 in. in thickness. Projectiles striking this armor made a short ricochet and slipped over the roof, if they were not heavy enough to crush the roof.

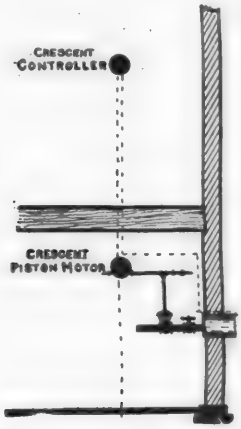
WILLIAM J. BALDWIN.

New York.

Temperature Control.

EDITOR HEATING AND VENTILATING MAGAZINE:

Referring to the correspondence of L. R. in THE HEATING AND VENTILATING MAGAZINE for September and your comments thereon, the writer would say that a system of electric temperature control, such as that described, was exhibited by W. H. Pearce & Co., of Chicago, at the last annual convention of the National District Heating Asso-



ARRANGEMENT OF CRESCENT TEMPERATURE CONTROLLER.

ciation, in Detroit. This apparatus is designed to control the temperature either in an entire building or apartment thermostatically and electrically, by opening or closing a valve of any size. It is so arranged that the temperature may be reduced during the night to, say, a drop of 25° F. With this device it is also possible to switch the temperature from day to night from a central station. The device was designed primarily for use in factories and apartments, such as those mentioned by L. R., and has been further developed and made applicable to central station heating, where the throwing of a switch, either manually or automatically, will switch the temperature in a number of buildings from a predetermined day temperature to a predetermined night temperature.

W. H. P.

Chicago, Ill.

All the vital features of government export control, stripped of their legal verbiage so that the busy man may grasp them quickly, are explained in the pamphlet "The Regulation of Exports Under the Espionage Act," which has just been issued by the Guaranty Trust Company of New York.

LEGAL DECISIONS

Landlord's Duty to Furnish Heat.

The New York Appellate Division, in Perry-Freeman Co. vs. Murphy (March 8, 1917), 14 N. Y. Supp., 74, holds that where a lessor, during the whole of a tenant's occupancy, failed to furnish heat as required and requested, he was guilty of a constructive eviction, which continued and was renewed after each monthly payment of rent.

Unfair Competition Defined.

In injunction proceedings to restrain unfair competition, the Iowa Supreme Court held the evidence sufficient to sustain findings that the defendant's furnace was substantially an imitation or duplication of a furnace manufactured by the plaintiff, that the similarity was intended to and did cause purchasers to buy the defendant's furnace, believing it to be that manufactured by the plaintiff, and that the defendant's advertising and sales methods constituted unfair competition.

What is unfair competition is a mixed question of law and fact, and has been variously defined and applied by the courts. In this case it was held to consist in the conduct of a trade or business in such a manner that there is an expressed or implied representation that the goods or business of the one man are the goods or business of another. It applies in cases where one simulates the particular device or symbol employed by another in such a way as to deceive the ordinarily prudent person, thereby leading him to believe, by the marks thus simulated, that the goods are the goods of another, and thus practicing a fraud upon the person whose goods he simulates, and upon the general public dealing in those goods.

The ground of the action of unfair competition is fraud, and this may be shown by direct testimony, or by facts and circumstances, or inferred from the manner in which the business is carried on.

This doctrine is applied in cases where one has established a business under a particular name, or by the use of certain marks or symbols, so that it has become known in the trade generally as designating the goods of that person. Courts of equity will enjoin one who fraudulently as-

sumes the same name, device, or symbol for the purpose of stealing away from the other the business so established, and thereby depriving him of the profit which flows from the business. There is no practical way, other than by prohibition, to prevent the filching of trade established by one in an article, through a name, symbol, or mark, than by prohibiting the use of the trade name or mark.

Even where the name, symbol, or device used is not one that can be protected as a trade name or mark, equity will protect one in the use of it, where it has, by long use, obtained a secondary meaning, as designating the goods of one particular person, and where, by the use of it, the public has come to know his goods by that name or symbol.

In determining whether a merchant is guilty of unfair competition, it is not alone the similarity in appearance of the goods of the plaintiff to those of the defendant that must be considered, but the methods, representations, and other matters in the conduct of the defendant's business. Lenox Furnace Co. vs. Wrot Iron Heater Co. (Iowa), 160 N. W., 356.

The War and the Heating Engineer

Heating Men in Military Service.

C. W. Chapman, of the Chapman Steam Specialty Co., Canton, O., has been given a captain's commission and is stationed in Washington.

M. G. Harbula, of the New York office of Warren Webster & Co., has enlisted in the Officers' Reserve Corps of the Aviation Section, Signal Corps, U. S. A.

George T. Palmer, chief of investigating staff for the New York State Commission on Ventilation, has been commissioned a first lieutenant in the Sanitary Corps of the army. He is stationed for the present at a point in Massachusetts.

Cantonment Heating.

After several weeks' conferences the plans for heating the cantonments for the new national army were settled. Seven of the cantonments will be heated by steam from central stations and nine will have warm-air furnaces.

Stephan Bros., Council Bluffs, Ia.; have the contract for heating the army cantonment at Fort Omaha. A central heating plant is being installed, with two 72 × 16 ft. Kewanee tubular boilers.

Great Lakes Naval Training Station at Waukegan, Ill., for which L. H. Prentice Company, Chicago, has the heating contract, was designed with the idea of giving the greatest amount of salvage possible, inasmuch as the buildings are only temporary and built on leased ground. All radiation is of the wall type, unpainted. The main supply lines are carried overhead, covered with 1-in. air-cell covering; the hot-water supply line and circulating line are also carried overhead on the same supports with the steam line. These pipes are also covered with 1-in. air cell covering and all three lines, steam, water supply and water return, are then wrapped with 4-ply roofing paper. Steam is supplied from numerous small boiler stations in which are installed from one to four standard Kewanee fire-box boilers, with special smoke extension on the rear, similar to traction engines. These boilers are of the standard type, not smokeless and are covered with asbestos cement 1½ in. thick. Each boiler has an individual steel stack. It is the intention to carry about 20 to 30 lbs. pressure on the main line. In each building there is a reducing valve and a single-pipe circuit along the wall of the building, below the radiators, with a single pipe feed to each radiator. The ends of these circuits are dripped through steam traps which discharge through a cooling radiator connected to the sewer. It was not deemed advisable to carry the condensation back to the boilers inasmuch as the installation would not show a saving in the three years of use. Only a few of the radiators are provided with valves. The hot water is also supplied from the central stations and a small electric pump is installed for maintaining the circulation. The water is heated by steam coils in storage tanks, supplemented by Kewanee garbage burners. H. M. Hart, manager of the L. H. Prentice Company, to whom we are indebted for the foregoing description, is in charge of the installation.

H. Kelly & Co., Minneapolis, Minn., is installing the $500,000 heating system at Camp Dodge near Des Moines, Ia., where drafted men from Minnesota and four other northwestern States are being trained. The system will include 18 large central steam plants and several smaller ones.

Camp Grant, at Rockford, Ill., will have a steam heating equipment costing more than $1,000,000. It will consist of 62 return-tube steam boilers of 150 H.P. each, supplying 450,000 sq. ft. of radiation. There will be 17 power stations at the camp.

Camp Custer, at Battle Creek, Mich., will consist of 1,200 buildings more than half of which are now completed. Most of the buildings are steam-heated from 15 large central heating plants. Each one of these heating plants is designed to care for the group of buildings housing a single regiment.

Food Pledge Week.

The week beginning October 28 is to be Food Pledge Week, during which the entire country will be canvassed on the food pledge and asked to sign and support it.

Plans for Second Liberty Loan in New York.

To carry the second Liberty Loan campaign into every trade in Greater New York and to enlist the support both of the customer and the employee, trade committees have been organized by the New York Liberty Loan Committee through its distribution committee. The chairman of the Machinery and Machine Tool Trade Committee is James W. Lane, of the E. W. Bliss Co., Brooklyn, N. Y. Other chairmen are: Steam and Hot Water Trade, J. E. Rutzler; Heat and Cold Insulation Trade, F. F. Cooper.

Work of the Engineering Council.

Among the activities of the Engineering Council, which is an organization composed of members of the four largest engineering bodies, is the procuring of men for special government service. A tabulation is also being made of the members of the societies represented, for use in the industries, especially after the war is over.

In organizing the council, provision was made for the election to membership of other national engineering and technical societies. The office of the council is in the Engineering Societies Building.

How To Reduce Coal Requirements.

A bulletin issued by the Chamber of Commerce of the United States emphasizes the following suggestions for reducing the coal requirements during the coming winter:

1. Inquire into the methods employed by your fireman and consider his methods in relation to those suggested by the Bureau of Mines.

2. Learn what plants in your locality secure the best results from coal.

3. Endeavor to have the wasteful users of coal profit by the best experience in the locality.

4. Improve all local methods by consultation with the Bureau of Mines and Study of the Stoking Methods Recommended by the Bureau.

5. Buy your coal as near home as possible.

As has already been announced, President Wilson, acting under the Food Control act, has fixed the prices of bituminous coal, f.o.b. mine, at from $2 to $3.50 per ton of 2,000 lbs., classified as to size, quality and locality. Jobbers in bituminous coal are permitted to add not over 15 cents a ton.

The maximum prices for anthracite coal for certain specified producers, f. o. b. mine, were fixed at from $4 to $4.30 per ton of 2,240 lbs., classified as to size, quality and production. All producers not specified are allowed to sell at prices not over seventy-five cents a ton higher than the prices fixed by the President.

Anthracite jobbers in Buffalo or east of that city, may add not more than twenty cents a ton of 2,240 lbs. to their purchase price; and jobbers west of Buffalo may add a gross margin of thirty cents per ton.

President Harry A. Garfield, of Williams College, has been appointed Fuel Administrator with power to execute the orders issued by the President.

The President has also appointed an administrative officer under the Priority Shipments Act to supervise shipments of coal. Certain railroads have been directed to ship bituminous coal to Lake Superior and Lake Michigan ports in order that it may be sent to the Northwest to supply the needs of that portion of the country.

In a statement issued by President Garfield he states:

"Until further direction, the following rulings will be observed:

"1. The President's order fixing prices became effective for bituminous coal Tuesday evening, August 21, 1917; for anthracite coal, Saturday, September 1, 1917. The President's order includes export and bunker coal.

"2. The prices fixed are provisional. They will stand unless changed by order of the President, for good cause shown. The Fuel Administration will examine all applications for revision of prices accompanied by cost statements presented in writing. These statements should be verified and cover at least the years 1915, 1916 and 1917, to date.

"If further explanation is needed the Fuel Administration will ask complainants to appear in person.

"It is not proposed to require efficiently operated mines to produce coal at a loss, but the burden rests upon applicants to show that the prices fixed in particular cases are unfair.

"3. It will greatly expedite the work of the Fuel Administration if associations, whether of operators, miners or industries affected, would postpone the holding of meetings for the appointment of committees to confer with the Fuel Administrator, or for the purpose of taking action concerning prices and wages, until he has had opportunity to select his advisers and hear from those who believe themselves likely to be adversely affected. Prompt atention will be given to all communications.

"4. Plans are under consideration and will be soon announced, whereby production may continue without affecting adversely either the producer or the purchaser pending the examination of applications for revision of prices. Until this plan is announced, it is suggested that sales and deliveries be made at the prices fixed with a stipulation to the effect that if prices are readjusted settlements shall be made accordingly.

"5. For the purpose of determining a proper basis for sales by retail dealers, local committees will be organized throughout the country. Each committee will investigate and report upon the local situation and advise concerning the regulations to be established. When the price is fixed the local committee will be asked to superintend its enforcement.

"6. The Fuel Administration is preparing a plan of apportionment which will secure to domestic consumers their fair share of the coal supply and at prices which will reflect the prices heretofore promulgated by the President.

"7. Contracts relating to bituminous coal made before the proclamation of the President on August 21, and contracts relating to anthracite coal made before the President's proclamation of August 23, are not affected by these proclamations, provided the contracts are bona fide in character and are enforceable at law.

"The undersigned has requested the Federal Trade Commission to secure at the earliest moment possible a certified copy of all contracts held to come within the foregoing rule."

An announcement issued by the Fuel Administration under date of October 1, fixed the retail prices of anthracite and bituminous coal, but these may undergo further revision in view of the coal strikes.

Government Orders.

American Radiator Company, it is reported, has been negotiating with the government with a view of turning over its plant at Bayonne, N. J., for the manufacture of guns. It is stated that this plant is at present engaged in filling government orders for naval guns. These orders, it is added, approximate $3,000,000 and will take from six to eight months to complete.

Hudson Boiler Mfg. Co., New York, has received an order from the War Department for a large number of hot water heaters for use in the army cantonments.

Kewanee Boiler Co., Kewanee, Ill., it is stated, has received orders from the government for heaters, boilers, tanks and garbage burners, approximating in value $912,000, with the prospect of more orders to come. These supplies will be used in the army cantonments, officers' training stations, aviation camps, etc.

Ilg Electric Ventilating Co., Chicago, Ill., has organized its office and factory employees into a military company. Drills are held every day at noon in front of the company's plant at 154 Whiting Street. A uniform style of working clothes has been adopted consisting of a khaki-colored oversuit.

American Association of Engineers.

Local chapters of the American Association of Engineers have been established in St. Paul, Indianapolis and Milwaukee. This makes a total of seven chapters which have been organized since the formation of the association, two years ago. The total enrollment of the association is now over 2,200 members.

Manufacturers of Smokeless Boilers.

The following list contains the names of manufacturers of smokeless boilers. This list shows some notable additions to that published last year and there are several firms which, though not at present making smokeless boilers, have plans fully matured for taking up this line. Two such typical firms are the Richmond Radiator Company, of New York, and the Thatcher Furnace Company, of New York.

LOW PRESSURE STEAM AND HOT WATER BOILERS.

American Radiator Co., Chicago, Ill.
John Brennan & Co., Detroit, Mich.
Coatesville Boiler Works, Coatesville, Pa.
Jesse C. Coogan, Milwaukee, Wis.
Federal Radiator Corporation, Newcastle, Pa.
Gurney Heater Mfg. Co., Boston, Mass.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hart & Crouse, Washington, D. C.
Herbert Boiler Co., Chicago, Ill.
Ideal Heating Co., Oskaloosa, Ia.
Kanawha Mfg. Co., Charleston, W. Va.
Kellogg-Mackay Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Molby Boiler Co., New York.
Newport Boiler Co., Chicago, Ill.
Wm. H. Page Boiler Co., New York.
Peck-Williamson Co., Cincinnati, O.
Peerless Heater Co., Pittsburgh, Pa.
Pierce, Butler & Pierce Mfg. Corporation, New York.
Frank Prox Co., Terre Haute, Ind.
Prudential Heating Co., Akron, O.
H. B. Smith Co., Westfield, Mass.
Spencer Heater Co., Scranton, Pa.
Thompson Heater Corporation, Buffalo, N. Y.
United States Radiator Corporation, Detroit, Mich.
Utica Heater Co., Utica, N. Y.

FIRE TUBE BOILERS.

Ames Iron Works, Oswego, N. Y.
John Brennan & Co., Detroit, Mich.
Brownell Co., Dayton, O.
Casey-Hedges Co., Chattanooga, Tenn.
Freeman & Sons Mfg. Co., Racine, Wis.
Gem City Boiler Works, Dayton, O.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hawkes Boiler Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Murray Iron Works Co., Burlington, Ia.
John O'Brien Boiler Works Co., St. Louis, Mo.
Oil City Boiler Works, Oil City, Pa.
Titusville Iron Co., Titusville, Pa.
Vogt Machine Co., Louisville, Ky.

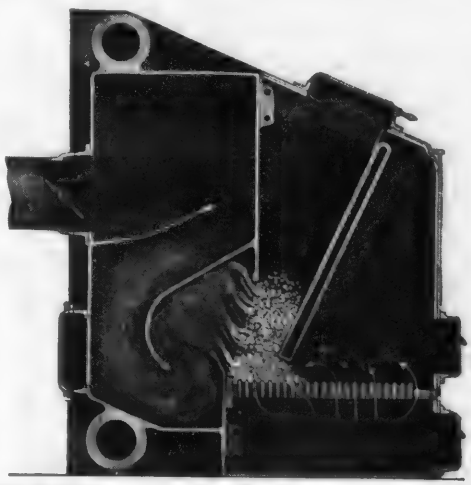
ACCESSORIES FOR SMOKELESS BOILER OPERATION.

Eureka Smokeless Furnace Co., Chicago, Ill. (Smokeless Furnaces)
Betson Plastic Firebrick Co., Terre Haute, Ind. (Fire Brick)

A New Adjustable Magazine Boiler.

A new type of house-heating boiler, with an adjustable magazine furnace, has been brought out by the Thompson Heater Corporation, Buffalo, N. Y. It is known as the Thompson boiler, being designed and perfected by C. B. Thompson, the president of the company and a well-known writer on heating subjects.

The most striking feature of the heater is the separation of boiler and furnace. With this arrangement, the fuel capacity may be increased without increasing the size of the boiler. The furnace may be adjusted to burn through any desired fuel



THOMPSON ADJUSTABLE MAGAZINE HEATER—ADJUSTED TO BURN PEA COAL.

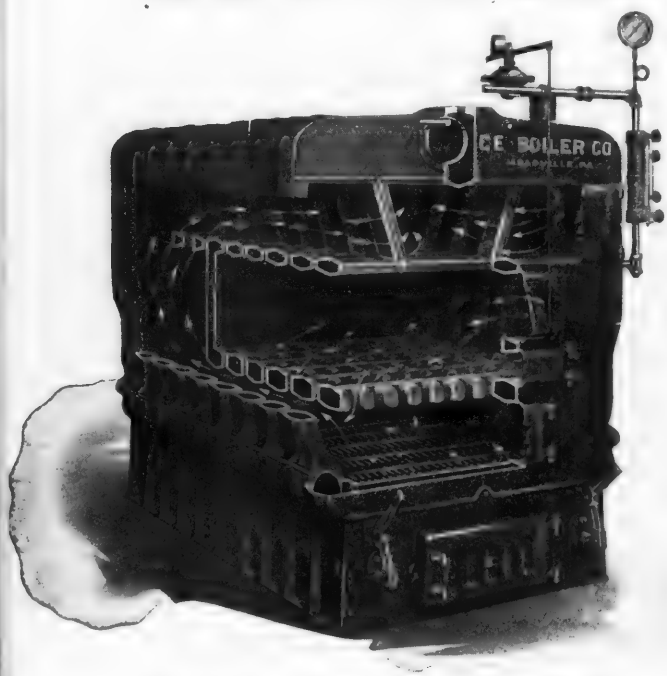
thickness to accommodate fuels of variable densities. Also, the furnace may be adjusted to burn any kind of fuel without changing the boiler in any way, Finally, the magazine furnace may be adjusted to burn various sizes of hard coal from stove size to buckwheat, as well as soft coal, without smoke.

In a catalogue published by the company descriptive of this new boiler, tables of boiler capacities are given for the various conditions of operation, worked out in detail according to the latest ideas for rating boilers. Colored photographs are shown of the construction of the boiler and there are also detail views of the center section showing the self-sealing material attached

to the flue walls and water-cooled grate attached. Size of catalogue 8 × 11 in. Pp. 19.

Monarch Down-Draft Smokeless Boiler.

A boiler that will burn any soft coal smokelessly, thereby guaranteeing immunity from smoke ordinances and a saving in the coal bill of from 25% to 33⅓%, is the description given of the Monarch down-draft smokeless boiler for soft coal exclusively, manufactured by the Wm. H. Page Boiler Co., 141-145 West 36th Street,



MONARCH DOWN-DRAFT SMOKELESS BOILER.

New York. This heater has two combustion chambers and grates, one directly above the other.

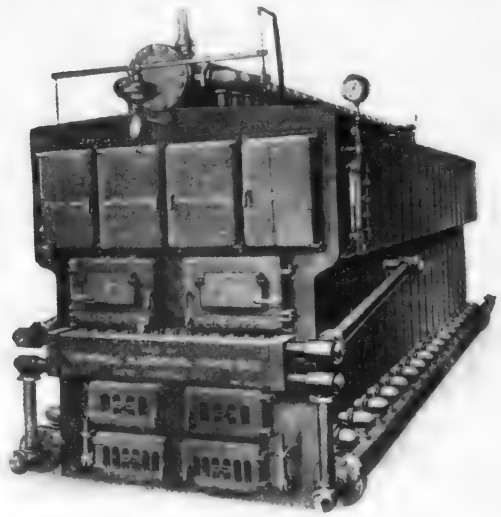
The upper grate is cast integral with the boiler section, each bar being hollow, the same as the boiler section of which it is a part. The inside area has been found ample to provide for free circulation and every part is backed with water to prevent any burn-out. The spaces between the grates and their hollow projections are proportioned to allow for the passage of the requisite supply of air for complete combustion. The water grate also forms an effective part of the heating surface in the boiler.

In the operation of this boiler, no fuel supply is required for the lower or secondary grate, the upper grate only being charged.

The Monarch boiler, it is stated, is particularly advantageous in sections where natural gas burners are used, as their installation in a building is an insurance against the time when the gas supply may become exhausted temporarily or permanently through accidents to mains, freezing, etc., as the disconnection of the gas burners, easily accomplished, permits the substitution of soft coal for fuel. Almost every style of gas burner is adapted to these boilers, making their convertibility an important feature. The boilers are made in a wide variety of sizes for either steam or hot water, the steam capacities running up to 9,000 sq. ft.

Three Characteristic Principles of the Federal Water-Tube Smokeless Boiler.

A smokeless boiler that embodies the features of the Hawley type of down-draft furnace, water-tube construction and a secondary combustion chamber, has been brought out by the Federal Radiator Co., New Castle, Pa. Of these three features,



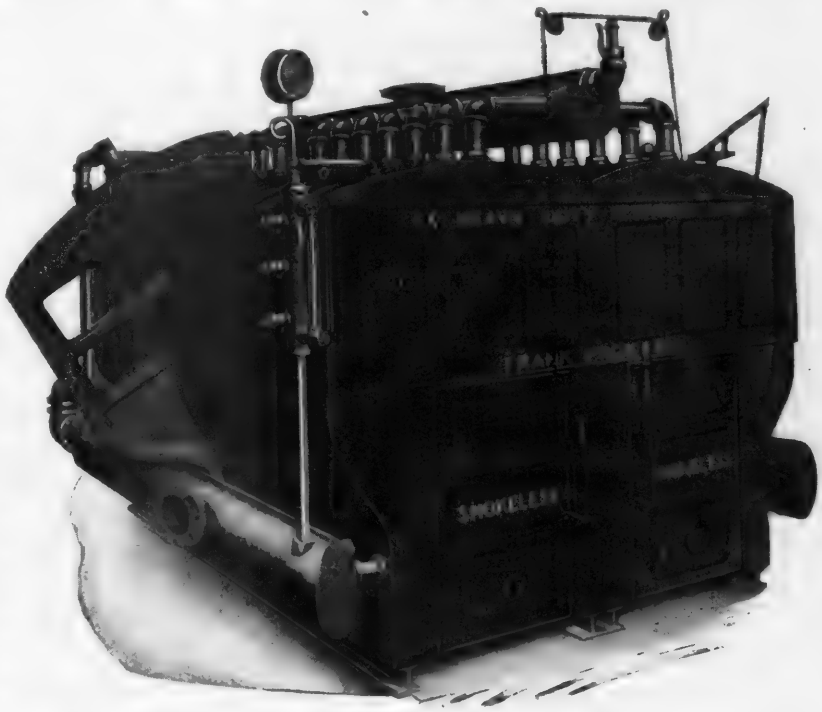
FEDERAL WATER-TUBE SMOKELESS BOILER.

special emphasis is laid on the secondary combustion chamber, as it is considered that this is just as essential in order to complete combustion and the uniting of the hydrocarbon gases, as to have a down-draft principle of burning the coal. The hydrocarbon gases, after passing the bridge wall, must expand and must be advanced to a higher temperature. This, it is claimed, can not be accomplished successfully unless

a large secondary combustion chamber is constructed so that these gases will not chill.

The large combustion chamber which is built without any obstruction, the Hawley type of down-draft furnace and the water-tube construction, combined with water space and steam-liberating space large enough to produce a steady condition of the water are among the advantages of this heater. The type of grate is such that it is possible to burn from 1 to 25 lbs. of coal per square foot of grate per hour. Any grate of soft coal may be used, it is stated, with smokeless results, high efficiency, and high evaporating power and in addition, the boiler may be overloaded when necessary.

By referring to the illustration it will be noted that the Federal boiler is of cast-iron sectional construction. Each section is made in two parts. The water-grate is in single units. No joints are exposed to the fire and any section or grate can be removed without disturbing the balance of the boiler. The boiler is made up to 20,000 sq. ft. in single units, all of the ratings, it is added, being based on actual evaporation. Bulletin 17, issued by the company, is devoted to this boiler and contains interesting details of its construction and operation.



SMOKELESS DUPLEX ECONOMIC EXTRA-HEAVY DOWN-DRAFT STEAM BOILER (SINGLE GRATE).

Types of Heavy-Duty Smokeless Boilers.

A line of down-draft boilers designed for heavy duty, has been brought out by the Frank Prox Co., Terre Haute, Ind., under the names of the "Smokeless" Economic extra-heavy and the Duplex Economic Heavy-Duty down-draft boilers. Of these two lines, one is known as the single-grate and the other as the double-grate type. The single grate boiler has the Prox patented rocking grate and the manufacturers state that this is the only down-draft boiler having a rocking grate. This rocking grate is mounted on a hollow bar which, being part of the section, has the same circulation of water, and is operated by shaker levers. The advantage of the rocking grate over the stationary type is that, with the rocking grate, the fire can be stoked uniformly, giving the entire area of the grate the same working condition and thereby increasing the efficiency.

The double-grate boilers are made with the stationary or rocking grates on the upper grate and rocking grates on the lower.

In all Prox down-draft boilers the upper grate, or grate tube, is a part of the section and has the same circulation of water as the section itself. It also makes erecting easy. The upper grate is designed to carry the water circulation, as it enters the bottom of the section, right across the downward travel of the burning gases. Excessive expansion and contraction at this point is provided for. Each type of boiler is made in two complete series, the data for which are given in one of the company's recent catalogues.

SMOKELESS ECONOMIC DOWN-DRAFT STEAM BOILER, WITH DOUBLE GRATE.

Success of the Imperial Smokeless Boiler.

The notable number of successful installations of the Imperial smokeless boilers, made by the Utica Heater Co., Utica, N. Y., especially in the locality of Chicago and vicinity, has brought this type of heater prominently before the trade. As its name implies it is designed to burn the cheapest grades of soft coal without producing objectionable smoke and the manufacturers state that they have yet to find a single instance where one of these boilers has failed to comply with the most rigid smoke ordinance, while using any grade of soft coal.

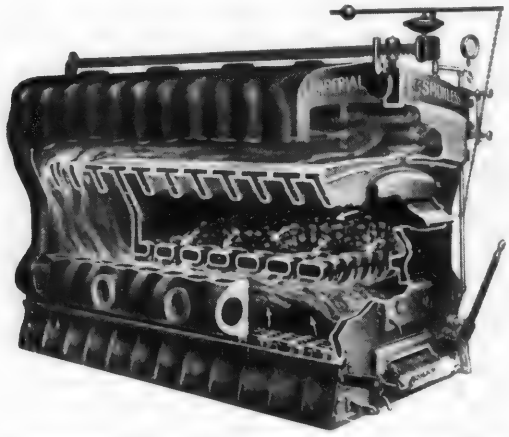
Aside from the special construction of the Imperial boiler, the arrangement of the double grates is mentioned as the secret of its success. Fuel is fed to the upper grate. Partially-consumed coal drops from the upper to the lower grate, thus giving a double fire, one with a down draft and the other upward, the two meeting with intense combustion. The special water grate used with this boiler is also included among its important features. Directly opposite the water grate on each section are placed 1¼-in. brass plugs to assure thorough extraction of all foreign matter and to provide easy access for inspection and cleaning.

This line is made in a 30-in. series and a 40-in. series for steam and water.

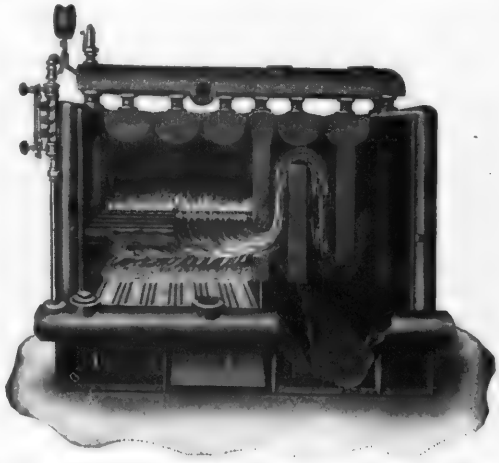
A Header-Type of Down-Draft Boiler.

An unusually long fire-travel, combined with an effective arrangement of heating surface, water tubes and grates, are the outstanding features of the Gurney down-draft smoke-consuming boiler, which is a product of the Gurney Heater Mfg. Co., Boston, Mass. This boiler embodies all of the well-known features of the Gurney Bright Idea water-tube construction. As will be noted from the illustration, these boilers are of the header type, affording a large steam reserve space, and the headers are connected to the sections by extra-heavy 3-in. nipples, with lock nuts.

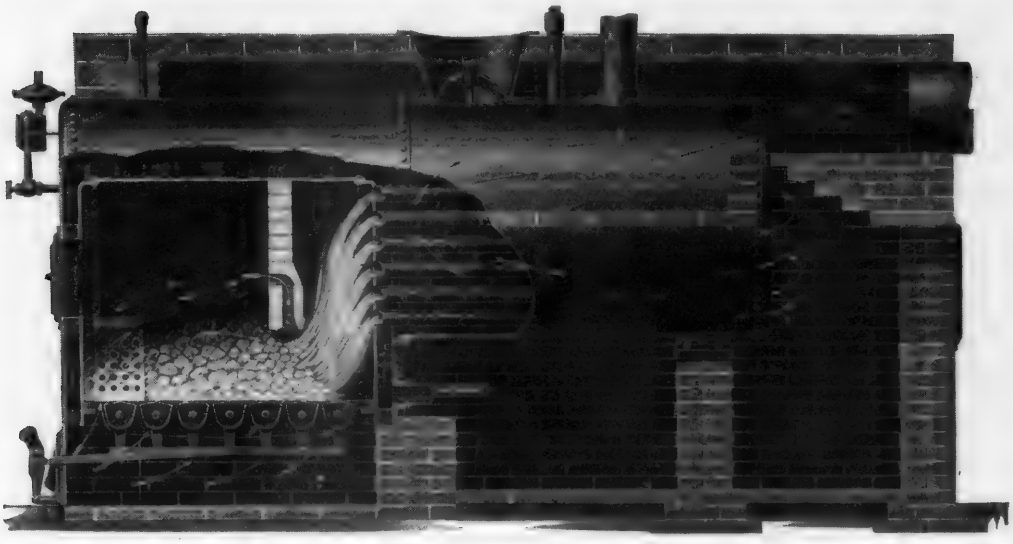
Among the details of construction may be mentioned the openings between the sections in the bottom of the gas-making chamber which afford easy access to the slice bars for cleaning without disturbing



CONSTRUCTION OF IMPERIAL SMOKELESS BOILER.



GURNEY DOWN-DRAFT SMOKE-CONSUMING BOILER.



METHOD OF INTRODUCING SUPERHEATED AIR IN COMBUSTION CHAMBER OF EUREKA SMOKELESS FURNACE.

the fire. Also ample space is provided in the gas chambers for the complete combustion. Finally, the water-travel is vertical, following its natural course. The company's catalogue contains dimensions, capacities, etc., for both the steam and water series, as well as a table of stack sizes for down-draft sizes, running from a 40-ft. chimney height for a 1,200-1,500 sq. ft. boiler to 100 ft. for a 14,500-15,000 sq. ft. boiler.

EUREKA SMOKELESS FURNACE INSTALLED IN ORDINARY FIRE-BOX BOILER.

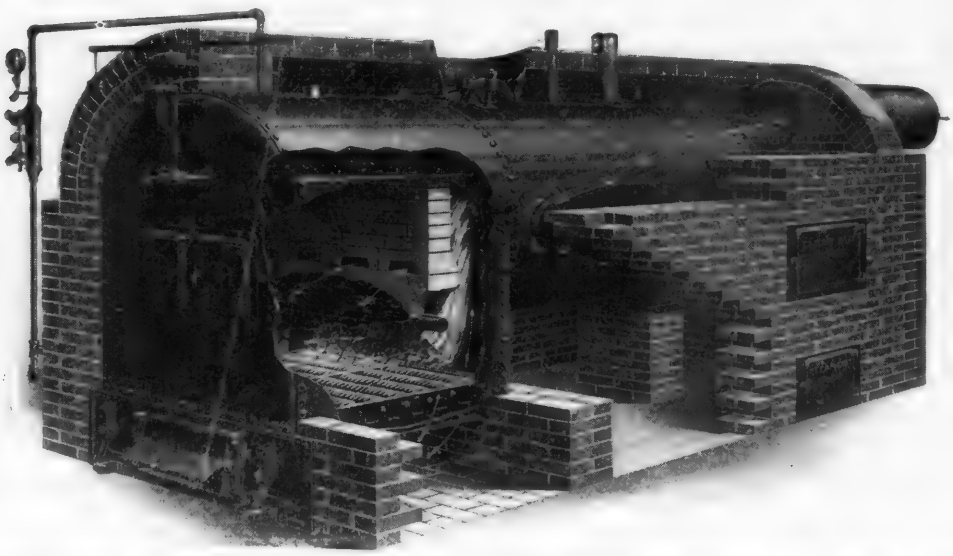
Features of the Eureka Smokeless Furnace.

Basing its claims on the point that an even distribution of air is quite as essential as the correct amount of air, the Eureka smokeless furnace is presented to the trade as being able to increase the efficiency of any boiler in which it is installed; that will burn Illinois or Indiana coal in full compliance with the city smoke ordinances; that will save at least one-fourth of the usual fuel cost; that will run automatically on three to five firings per day and maintain satisfactory pressure of steam or vapor; and, finally, that will burn more air and less coal than other furnaces. Regarding the air distribution it is stated that hot air is not only distributed over the coal bed, but is also injected into the gas chamber back of the hollow Eureka fire wall, where all gases become ignited and consumed, at a high temperature, before entering the boiler tubes.

The fact that the Eureka smokeless furnace is endorsed and commended by the Chicago Smoke Bureau is an interesting commentary on the efficiency of this heater, especially as the manufacturers had nothing to do with the tests on which the endorsement was based. One of the catalogues, "A Burning Question," contains a full report of the test. The manufacturers are the Eureka Smokeless Furnace Co., 1215 Chamber of Commerce Building, Chicago, Ill.

"Oil City" Smokeless Boilers.

An effective design for a smokeless re-

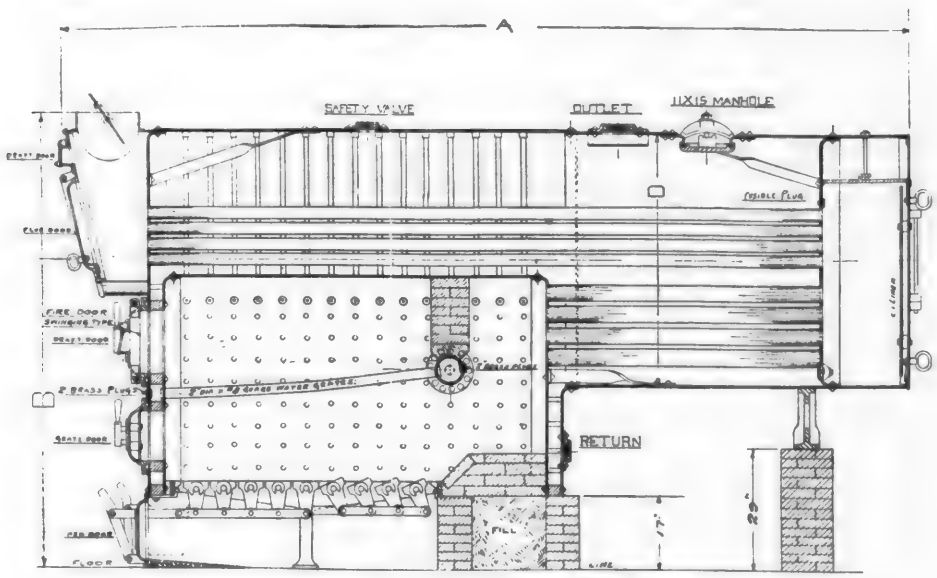


ARRANGEMENT FOR ADMITTING AIR THROUGH EUREKA DEVICE AND THE SUBSEQUENT PASSAGE OF GASES.

turn-tubular fire-box boiler has been developed by the Oil City Boiler Works, Oil City, Pa., as shown in the accompanying illustration. This boiler is of the self-contained type, and is fitted with a water or down-draft grate, for the abatement of smoke. It is designed to meet the requirements of laws adopted by many of the larger cities for the elimination of the smoke nuisance.

It will be noted that the boiler is really a combination of the principal features of the locomotive and horizontal tubular boilers. The return flues of the horizontal tubular type are added to the internally-fired locomotive type, while at the same time the brickwork is eliminated.

The furnace is surrounded by a steel water-jacket. Coal is fired on the upper or water grates. The products of combustion pass downward over the fire on the lower grates and thence through the tubes. Care is taken to prevent short circuiting or dead corners. The tubes are small in diameter which permits them to be made of a uniform thickness of metal.



LONGITUDINAL SECTION

CONSTRUCTION OF "OIL CITY" SMOKELESS BOILER

Another point mentioned for this boiler is that all the heating surface is easily kept clean.

Behind the "Oil City" smokeless boiler is the organization of the well-known Oil City Boiler Works. The boilers are built of flange steel, instead of tank steel and the manufacturers lay stress on the high character of the workmanship used on this line. The sizes run from capacities from 2,000 sq. ft. to 16,000 sq. ft. of direct steam radiation. A circular issued by the company gives these and other details.

A Portable Pitot Tube for Gases.

A Pitot tube designed for blower testing, ventilation work, testing of flow of gas in mines, aeroplane testing, foundry blowers, or any application where it is desired to determine the velocity of air or gas, has been brought out by A. H. Anderson, mechanical engineer, 3,300 Federal Street, Chicago, Ill. This form of Pitot tube originated and was developed in the laboratories of the Armour Institute of Technology, Chicago.

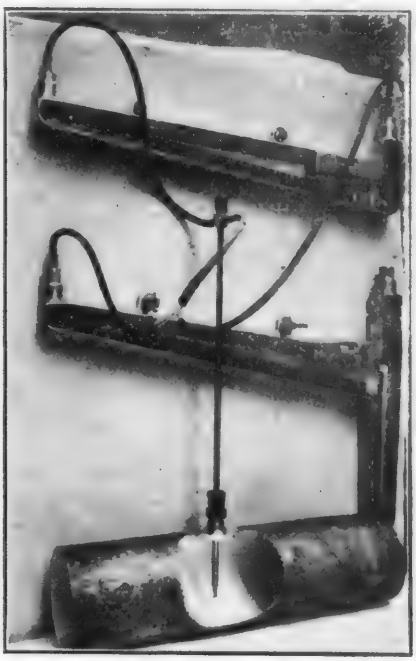


FIG. 1—PITOT TUBE AND TWO DIFFERENTIAL GAUGES. PIPE CUT AWAY TO SHOW TIP OF TUBE.

The tube is so compact that it may be inserted or withdrawn through the stuffing box without inclination of the tube. The stuffing box prevents leakage, and also clamps the tube in any position desired.

The scale engraved on the stem of the tube indicates the distance the tip of the tube projects into the pipe. The two arms at the top indicate the direction in which the tip is pointed; when these arms are placed at right angles to the pipe, as nearly as can be judged by eye, the results will be accurate within a very small percentage. One arm is stamped "S" for the static opening; the other is stamped "D" for the dynamic opening. Each of these arms is connected by rubber tubing to the proper end of the differential gauge.

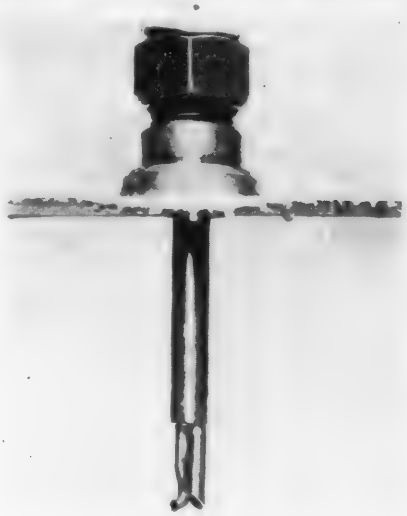


FIG. 2—ENLARGED VIEW OF TIP OF TUBE, SHOWING STATIC AND DYNAMIC OPENINGS.

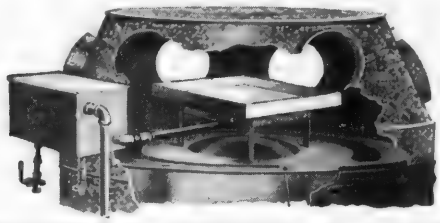
An instruction sheet accompanies each tube, illustrating the application to various gases. A list of constants is given for different temperatures, pressures, humidities, and kinds of gas, and computation is reduced to a minimum.

Each tube is carefully calibrated for the range of velocities for which the tube is to be used.

An Automatic Humidifier for Warm-Air Furnaces.

An adaptation of the Buddington humidifier used on radiators, to warm-air furnaces, is announced by the Reid-Geisler Mfg. Co., 5238 Ravenswood Ave., Chicago, Ill. It is stated that one Buddington automatic humidifier, as made for use in furnaces, will moisten the air throughout the ordinary house. The humidifier is connected to the city water supply and automatically refills itself as the water is evaporated. It can be installed in practically any warm-

air furnace. It consists of a vitrified enamel evaporating pan which rests on top of the dome over the fire-box, where it gets the maximum heat. This is connected by a water pipe to the water chamber, which is suspended from the ceiling, or placed on a suitable shelf outside the furnace. Inside of the chamber is a float valve which keeps the water level equal in this chamber and in the evaporating pan.



BUDDINGTON HUMIDIFIER AS ADAPTED TO WARM-AIR FURNACE.

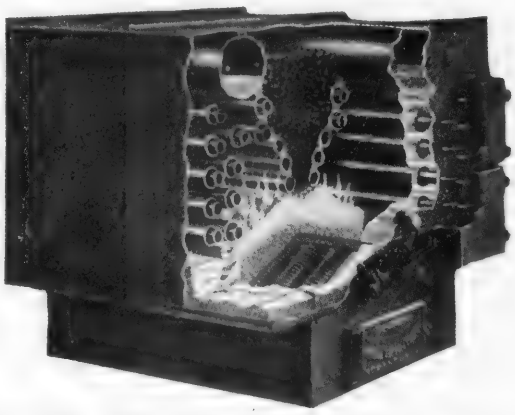
This device is intended to automatically mix just the proper amount of moisture with the heat, operating in direct proportion to the amount of heat generated. It is made in two sizes.

Trade Literature

SPENCER SUPER-STANDARD HEATERS, adapted for steam, vapor or hot water and combining the advantages of magazine-feed, sloping grate construction and ability to burn low-priced coal, including bituminous, are brought to the attention of the trade in a comprehensive catalogue that takes up in detail all the important features of construction and operation of this heater. One section of the catalogue is given over to "the Spencer's superior economy in coal bills," based on its magazine-feed and sloping grates. In the second section, the automatic action of the heater, designed to reduce both coal cost and human labor to a minimum, are explained, there being no shoveling of coal on the surface of the fire, while the sloping grates permit the coal to be distributed evenly. One of the unique features of this heater is that its magazine has a water-jacket on its outside, adding to the water exposure and at the same time keeping the coal cool till wanted. An important advantage of the sloping grate construction is that the two sections are independent of each other so that the fire on one section may be kept up and that on the other section allowed to go out, if desired, as in mild weather. All of the Spencer water heaters are made in sectional form, but the steam and vapor boilers are built of special "Spellerized" tubes, straight, parallel and nearly horizontal. This construction follows in general the lines of high-pressure boilers and is designed to gain greater

SPENCER HOT-WATER HEATER SHOWING SLOPING GRATE CONSTRUCTION.

efficiency and economy of operation. Special views are included showing how the various parts are designed and assembled. The steam heaters are made with double tubes, the outer tube conveying the water and the inner tube the gases, with direct heat from the fire



SPENCER STEAM HEATERS ARE MADE WITH DOUBLE STEEL TUBES.

playing on the outer tubes. Typical buildings of various types are shown, accompanied with copies of letters from owners who have had Spencer heaters installed. Under "Further Facts of Importance," hints are given on the selection and installation of these heaters, records from university and other tests, valuable hints on chimney construction and engineering data on factors determining boiler capacities. Price lists are also included for each size and type. The manufacturers are the Spencer Heater Co., Scranton, Pa. Size of catalogue 8½ × 11 in. (standard). Pp. 40.

Chimneys

Note:—The following tables and memoranda on chimneys are selected from a discussion of the subject by Harold L. Alt, which appeared in THE HEATING AND VENTILATING MAGAZINE *for March and April, 1917, and to which the reader is referred for more complete information.*

The most common error made in regard to chimneys is that of not distinguishing between the size (which governs the volume of smoke they can handle) and the height (which determines the intensity of the draft). A chimney may be *high* enough yet with an *area* too small to do the work required. On the other hand it may be *large* enough but too *low* to produce a *draft* of the strength required to pull the air through the fire and up the chimney at a sufficiently rapid rate. Either fault, or a combination of both, will result in unsatisfactory service and will require remedying.

Heated air expands and occupies a greater volume than the outer air of a lesser temperature, so if a cubic foot of air outside the chimney weighs 0.07 lbs. and a cubic foot of the chimney gases at their higher temperature weighs only 0.04 lbs. then every vertical foot of air in the chimney means an unbalanced pressure of 0.07 — 0.04, or 0.03 lbs. per square foot at the base. This unbalanced pressure has a tendency to equalize by the rising of the lighter gases but since their place is taken by more heated gases coming directly from the fire the temperature, of course, never does equalize and the action continues its operation as long as the fire is kept burning.

From this basic principle all chimney action is governed and many chimney failings can be explained. For instance, the draft of a chimney is never as good in summer as in winter because the outside air is colder in the winter, the expansion of the chimney gases at the same temperature is, therefore, relatively greater and the intensity of the chimney draft is consequently increased.

Chimneys have to overcome their own losses, these losses consisting of the friction of the gases rubbing against the sides in their upward passage. For this reason a *circular-shaped flue* is most desirable, the next, square, and after that oblong with the *long* side *not more* than *double* the length of the *short* side. In flues where it is necessary to exceed this proportion *two* separate flues of more desirable shape can sometimes be used with advantage.

The most efficient chimney, as far as draft is concerned, is one built perfectly straight from the bottom up, round (or nearly round) in the shape of the interior flue, and lined with tile, or with the interior surface made as smooth as possible by other means. There is no advantage in tapering the inside of a chimney to a smaller size toward the top—this only retards the flow of the gases.

A square chimney can hardly be figured as having its full area effective, a *deduction* of 10% to 15% being necessary on account of the spiral movement of the gases leaving the corners dead and inactive. With an oblong shape the effect is worse, a deduction of 25% being none too much. The use of tile flues will not only aid this slightly, owing to their rounded corners, but will also safeguard much of the fire risk otherwise due to mortar falling out between the bricks as time passes and leaving openings through which a spark might pass. As the tile serves to retain the gases and smoke it also prevents leakage which can spoil a chimney action at any time, no matter how perfectly the flue may otherwise be built.

RESIDENCE CHIMNEYS

The ordinary residence usually employs a chimney between 25 and 60 ft. high, the area being proportional to the size of the house and it is interesting to note that it is possible to burn No. 1 buckwheat coal with a chimney 55 ft. high, if the fire bed is not made too thick. Down-draft boilers should have chimneys at least 60 ft. high to operate successfully.

Having a chimney built upon desirable lines, as far as draft is concerned, it may, of course, still be too small, and in this connection it might be said that no flue should be made *less* than 8 in. diameter or 8 in. × 8 in. square. Under ordinary conditions, with steam, furnace or hot water heating, the following sizes of flues given in the table will be found to give satisfaction in residences whose cubic footage does not exceed the amounts shown:

SIZES OF FLUES FOR RESIDENCES.

Cubic Contents of Building. Cubic Feet.	*Round.* Inches Diam.	*Square.* Inches.	*Oblong.* Inches.
20,000	8	8 × 8	6 × 10
40,000	9	9 × 9	8 × 12
60,000	10	10 × 10	8 × 14
110,000	12	12 × 12	10 × 18
120,000	14	14 × 14	12 × 18
130,000	16	16 × 16	12 × 18
150,000	18	18 × 18	14 × 20

When flue tile is used the interior dimensions are not in even figures, the exact dimensions of commercial sizes being given in the table below:

COMMERCIAL SIZES AND AREAS OF FLUE TILE.

Square or Oblong Outside Dimensions, Inches.	Circular Inside Dimensions, Inches	Area Sq. in.
..	8	50
8½ × 8½	..	52
..	9	64
..	10	78
8½ × 13½	..	80
..	11	95
..	12	113
13 × 13	..	126
..	13	133
13 × 18	14	154
..	..	169
..	15	177
..	16	201
..	17	227
18 × 18	..	240

RESIDENCE CHIMNEYS

When square or rectangular chimneys are designed for fire places which burn wood or bituminous coal they are usually made with an area of 10% to 12% of the fire place opening, while with round flues the area may be reduced to 8%. For anthracite coal the rectangular or square flue may be reduced to 8% and the round flue to 6%. Ordinary stoves are readily served with an 8 in. × 8 in. flue, provided no other connections are made to it.

All chimney walls should be 8 in. thick to avoid danger of fire from sparks working through the joints, and the building laws in some cases demand not only 8 in. thick walls but tile linings as well.

The *height* of residence chimneys, as before mentioned, is usually of small moment, since the use of larger sizes of anthracite coal is common under such conditions. The draft, however, ought to approximate in inches of water the various values given in the table below after being in use twenty-four hours and with all the inlets suddenly closed.

DRAFT IN CHIMNEYS FOR RESIDENCES.

	Temperature of Outgoing Gases, Deg. F.		
Height in Feet.	200	250	300
	Inches.....of.....Water		
60	0.27	0.32	0.35
55	0.25	0.29	0.32
50	0.23	0.26	0.29
45	0.21	0.23	0.26
40	0.18	0.21	0.23
35	0.16	0.19	0.20
30	0.14	0.16	0.17
25	0.12	0.14	0.14
20	0.09	0.11	0.12

The figures given are about 90% efficiency of the theoretical draft which an absolutely tight chimney would show and a properly constructed chimney should approximate these figures.

CHIMNEYS

The first factor to develop in determining the proper diameter and height of the chimney required is the maximum number of pounds of coal burned per hour and the number of pounds of air required. If the actual boiler horsepower to be developed at the maximum can be computed or assumed the number of pounds of coal for various efficiencies may be read directly from the following table:

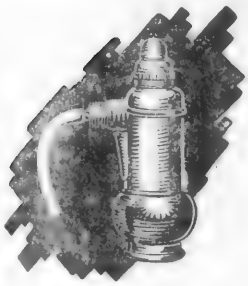
REQUIRED POUNDS OF COAL AND AIR FOR HORSEPOWERS AT VARIOUS EFFICIENCIES

Total Lbs. of Coal	POUNDS OF COAL PER BOILER H. P. DEVELOPED							Lbs. of Air per Sec.
	4	4½	5	5½	6	6½	7	
	HORSE POWER DEVELOPED							
50	12	11	10	9	8	8	7	0.25
100	25	22	20	18	16	15	14	0.5
150	17	33	30	27	25	23	21	0.75
200	50	44	40	36	33	31	29	1.0
300	75	67	60	55	50	46	43	1.5
500	125	111	100	91	83	77	71	2.5
750	187	167	150	136	125	115	107	3.7
1,000	250	222	200	182	167	154	143	5.0
1,500	375	333	300	273	250	231	214	7.5
2,000	500	444	400	363	333	308	286	10.0
2,500	625	555	500	455	416	385	357	12.5
3,000	750	667	600	545	500	461	429	15.0
4,000	1,000	889	800	727	667	615	571	20.0
5,000	1,250	1,111	1,000	909	833	769	714	25.
7,500	1,875	1,667	1,500	1,364	1,250	1,154	1,071	38.
10,000	2,500	2,222	2,000	1,818	1,667	1,538	1,429	50.
15,000	3,750	3,333	3,000	2,727	2,500	2,308	2,143	75.
20,000	5,000	4,444	4,000	3,636	3,333	3,077	2,857	100
30,000	7,500	6,667	6,000	5,454	5,000	4,615	4,286	150.
40,000	10,000	8,889	8,000	7,273	6,666	6,154	5,714	200.
50,000	12,500	11,111	10,000	9,091	8,333	7,692	7,143	250.
75,000	18,750	16,667	15,000	13,645	12,500	11,538	10,714	375.
100,000	25,000	22,222	20,000	18,181	16,667	15,384	14,286	500.
125,000	31,250	27,778	25,000	22,745	20,833	19,230	17,857	625.
150,000	37,500	33,333	30,000	27,273	25,000	23,076	21,428	750.
200,000	50,000	44,444	40,000	36,363	33,333	30,768	28,576	1,000.
300,000	75,000	66,667	60,000	54,545	50,000	46,154	42,857	1,500.
400,000	100,000	88,887	80,000	72,727	66,667	61,536	57,143	2,000.
500,000		111,111	100,000	90,909	83,333	76,923	71,428	2,500.
750,000				136,455	125,000	115,380	107,143	3,750.
1,000,000							142,860	5,000.

Note—Include every bend from the boiler uptake to the stack, counting the turn upward in the stack as one bend.

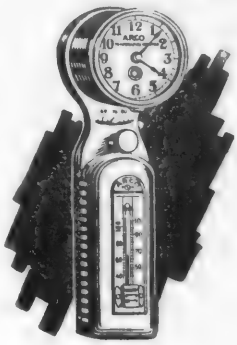
Better heat service with Ideal Specialties

Norwall Siphon Air Valve



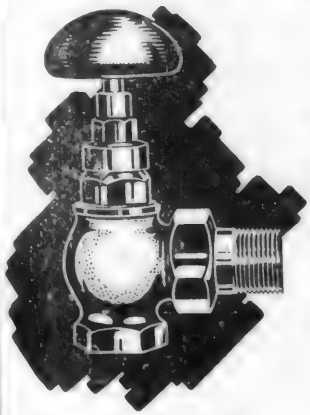
Sensitive and quick action — opens instantly to let out air. Closes tight against steam or water—never needs adjustment. Gives radiator full heating power and guaranteed for 5 years.

Arco Temperature Regulator



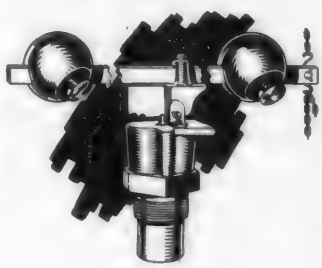
Maintains right temperature without care or attention. Prevents under-heating and over-heating. Turns on dampers in early morning and furnishes cooler night temperature. For any radiator outfit or hot air furnace.

Sylphon Packless Radiator Valve



Absolutely steam and water tight — without packing. Nothing to wear out or rust out. Cool handle easily turns — never binds, sticks or leaks. Eliminates damage from leaks.

Sylphon Water Regulator



No. 45A

Automatically regulates drafts. Saves fuel, prevents boiling and maintains uniform temperature. Also used on Hot Water Supply Boilers, for warm water for domestic use.

Use the above in all heating work calling for refined regulation and economical use of fuel. Send for special explanatory booklets

AMERICAN RADIATOR COMPANY

Branches in most large cities

Trade Literature.

NASH HYDRO TURBINE, described as the most simple compressor and vacuum pump, is the title of a unique circular published by the Nash Engineering Co., South Norwalk, Conn. The cover illustration shows the exterior of the pump and on opening the cover flaps which fold toward the center of the page the interior of the pump is disclosed, showing the principle of operation. The back of the circular shows the other side of the pump from the outside. A short description of the pump is included.

BRAEMER PSYCHROMETRIC CHART, measuring 25½ × 10 in., has been issued by the Braemer Air Conditioning Corporation, Philadelphia, Pa. Special attention is called to the convenient arrangement of the chart which contains printed directions for its use. The chart is intended to be framed or may be placed on a desk under a glass top for ready reference. The company states that the scientific principles upon which the chart is based also govern the Braemer air conditioning and humidity control system.

SYRACUSE PACKLESS VALVES is the subject of an unusually full catalogue issued by the Syracuse Faucet & Valve Co., Eastwood, N. Y. This company specializes in the construction of packless valves. All joints, before they are screwed tight, are lubricated with a mixture of heavy oil and graphite, so that the valve may be loosened without injury to the parts. A large octagon nut is also milled on the lower end of the bonnet to prevent straining the metal of the bonnet in tightening it up. The manufacturers, it is stated, carry a large stock of all standard styles of valves. The illustrations include views of each style of valve, and several pages are also devoted to roughing in dimensions of valves for use in roughing-in job before the valves are received. Size 6 × 8½-in. (folded). Pp. 94.

Death.

Arthur Kneisel, treasurer of the American Association of Engineers, died in Chicago, August 27. Mr. Kneisel had just retired as secretary of the association. He took an active part in its formation. Mr. Kneisel was 37 years old.

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Coming Events.

October 17-20, 1917.—Annual meeting of the American Public Health Association, in Washington, D. C.

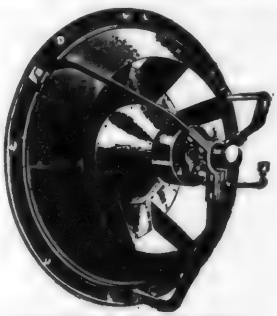
December 4-7, 1917.—Annual meeting of the American Society of Mechanical Engineers in New York. Headquarters at the Engineering Societies Building.

Miscellaneous Notes.

William H. Hill, vice-president of the American Radiator Co., Chicago, has been elected a director of the Stover Mfg. & Engine Company.

Indianapolis, Ind.—The Citizens' Gas Company has issued a warning to all householders to discontinue the use of gas for heating purposes in cases where the gas heat is used as a substitute for coal. The warning does not apply to gas or kitchen stoves for hot water heating or for manufacturing purposes. The prohibition as to the use of gas in grates and for heating purposes is not temporary, but, according to J. D. Forrest, secretary and general manager of the company, will continue all winter. It is stated that the company now has a sufficient supply of coal on hand but the fact that thousands of householders have neglected to put in their supply of coal and are using gas as a substitute has strained the plants of the company beyond their capacity. The company's statement contains the warning that customers who continue to heat their houses with gas may be cut off from the gas service.

Grand Rapids, Mich.—A new ordinance to govern the Grand Rapids smoke nuisance is being drafted by City Attorney Taggart, Service Director Cutcheon and Smoke Inspector Smith. The new ordinance, it is stated, will be far more stringent than



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the present one and will provide for the installation of proper smoke devices and the regulation of furnace stoking.

Portland, Ore.—Chairman Rufus C. Holman of the Board of County Commissioners has ordered an immediate report on the probable cost of transforming the heating plants in the court house, county hospital and poor farm from oil to coal-burning plants. It is expected that, owing to the shortage of oil and coal, wood will have to be used in some of the county buildings.

Porland, Ore.—Difficulty is being experienced in Multanomah County to procure enough oil fuel for the various heating plants. Appeals to the government have so far been met with the statement that all arrangements must be made with the oil concerns. Many plants are facing the possibility of reconstructing their furnaces to burn coal or wood.

Des Moines, Ia.—In connection with work on the capitol extension tract, it is being planned to move the capitol heating plant just north of the State House to a point on the southeast corner of the grounds.

Central Supply Association will hold its twenty-third annual meeting in Chicago, October 17, at the Congress Hotel. The principal speaker will be H. Walton Heegstra, who will deliver an address on "Organization Salesmanship."

Prof. James D. Hoffman, Lincoln, Neb., has completed his work at the University of Nebraska and will return to Purdue University, Lafayette, Ind. During his connection with the University of Nebraska, Prof. Hoffman established courses in heating and ventilation, similar to those instituted by him at Purdue University.

National Warm Air Heating and Ventilating Association has published the proceedings of its fourth annual convention, held in Cleveland last June. The volume contains the discussions in connection with trade acceptances and association advertising of warm-air furnace heating, as well as the report of the committee on army cantonment heating and the paper by Prof. A. C. Willard on "Advancing Furnace and Heating." The book contains 80 pages and is issued from the office of Secretary Allen W. Williams, Columbus, O.

Building Operations for August show a decrease of 33% over the corresponding period in 1916. This, however, does not take into account the immense amount of government work which does not figure in the municipal reports. A large part of the recent government construction work is outside of city limits. The building per-

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Write for Bulletin 127

The Powers Regulator Co.

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365 The Federal Street Building, Boston

mits issued in 114 American cities, according to the *American Contractor,* Chicago, amounted to $49,118,123 as against $73,614,908 in August, 1916. Among the cities showing increases were: Atlanta 98%, Atlantic City 171%, Cleveland 66%, Denver 98%, Duluth 60%, Milwaukee 56%, New Bedford, Mass., 518%, New Haven 51%, New Orleans 61%, Omaha 19%, Sacramento 39%, San Francisco 23%, Syracuse 63%, Trenton 24% and Wilmington 121%. Cities reporting decreases included: Akron 65%, Albany 75%, Baltimore 49%, Boston 1%, Buffalo 31%, Chicago 26%, Cincinnati 30%, Columbus 48%, Detroit 53%, Indianapolis 21%, Kansas City 50%, Los Angeles 14%, Louisville 80%, Minneapolis 47%, New York 41%, Philadelphia 65%, Pittsburgh 51%, St. Louis 30%, Toledo 72% and Washington 12%.

Manufacturers' Notes.

Crane Company, Chicago, announces the opening of new exhibit rooms in New York, at 23 West 45th Street and 22 West 45th Street.

Warren Webster & Co., Camden, N. J., announce the removal of their Detroit branch office to new and enlarged quarters at 2123 Dime Bank Building. A. B. Knight is the company's district manager in Detroit.

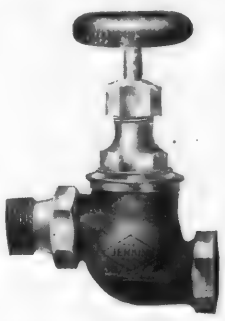
Illinois Engineering Co., manufacturer of the Illinois vacuum and vapor heating systems and of the Davis and Hughson steam specialties, has purchased a new factory building at 21st Street and Racine Avenue, Chicago. The building occupies a plot of about 30,000 sq. ft., and is of modern concrete, steel and brick construction.

Frank L. Patterson & Co. and Benj. F. Kelley & Son, New York, announce a combination of their interests. Hereafter their joint business will be conducted under the name of The Patterson-Kelley Co., Inc., with main offices at 26 Cortlandt St., New York. The company will specialize as water heating engineers and manufacturers of heaters.

Fulton Co., Knoxville, Tenn., has appointed H. F. Old as manager of its New York office, succeeding E. M. Lloyd.

Central Station Heating Notes.

Birmingham, Ala.—B. H. Cooper, Birmingham's representative on the Alabama Public Service Commission, has been authorized by the commission to hold a preliminary hearing of evidence in the matter of the Birminghams Railway, Light & Power Company's proposed heat rate increase. The company seeks to make an advance of 17½% on the rate of city heat, claiming this to be in accord with the increased prices of coal. At a previous hearing before the commission the consumers op-



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There's a Jenkins Bros. Valve for practically every purpose. Specify them on your work.

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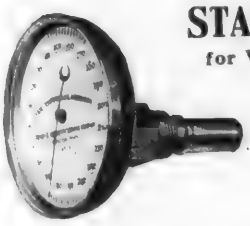

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They are practically indestructible, are sensitive to changing temperatures and are very easily installed. Supplied with horizontal or vertical extension and standard pipe thread.

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STANDARD THERMOMETER COMPANY, 65 Shirley St., Boston, Mass.

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posed the increase on the ground that the coal now used in operating the plant should be charged to the electric department and that, in any case, the proposed increase is excessive. It was brought out that the cost of operating the plant is now divided between the steam heating department and the electric department, two-thirds being assessed against the heating department.

Marquette, Mich.—It is reported that a central heating plant, to serve at least five buildings on Washington Street, will be installed by the Peter White Land Company, of Marquette. M. W. Jopling is now considering estimates and proposals. The buildings to be served would include the opera house block, the Colonial Building, the office building west of the opera house and the buildings occupied by the Mining Journal and by the Michigan State Telephone Company. The plant now proposed is of the high-pressure type, the pressure being reduced for the individual heating systems.

Anderson, Ind.—A petition has been filed with the Indiana Public Service Commission, on behalf of the Central Heating Company, of Anderson, asking that the company be permitted to increase its rates during the season of 1917-1918, because of the increased cost of coal. Included in the petition are two schedules. One proposes that steam rates be advanced in event the petition by the railroads for increased freight rates on coal is granted. The other suggests a lower rate in event the railroads' petition is denied. The two rate schedules are as follows, the first rate given being that asked in event the petition for increased freight rates is not granted:

81 cents, 84 cents per 1,000 lbs. condensation for the first 10,000 lbs.

74 cents, 77 cents per 1,000 lbs. for from 10,000 to 20,000 lbs.

68 cents, 70 cents per 1,000 lbs. for from 20,000 to 100,000 lbs.

61 cents, 63 cents per 1,000 lbs. for from 100,000 to 150,000 lbs.

55 cents, 56 cents per 1,000 lbs. for from 150,000 to 400,000 lbs.

49 cents, 51 cents per 1,000 lbs. for all over 400,000 lbs.

A discount of 5% for prompt payment is provided in the petition.

Youngstown, O.—Work on new steam lines for heating public buildings this winter

You Need Have no Fear of Heating Troubles This Winter, if You Install The WEBSTER System *NOW*

The WEBSTER System is a method of circulating exhaust steam, live steam, or a combination of the two, to obtain not only the utmost efficiency, but the greatest economy.

Wasting exhaust steam, which might be put to profitable use in heating, is actually throwing money away, since all exhaust steam not so utilized requires additional live steam to be generated, at the expense of fuel and labor, besides the extra wear on the power plant

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has been installed in over 10,000 buildings during the past 29 years. This record has been achieved only by giving uniformly successful results.

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Old buildings can be "Websterized," very often at comparatively little expense.

The WEBSTER System over comes "water-hammering," air-binding and excessive coal bills. Circulation of the steam is secured with little or no back pressure upon the engine. Webster Modulation Valves control the temperature in each room or department. Webster Sylphon Traps automatically discharge all air and condensation from radiators and pipe coils.

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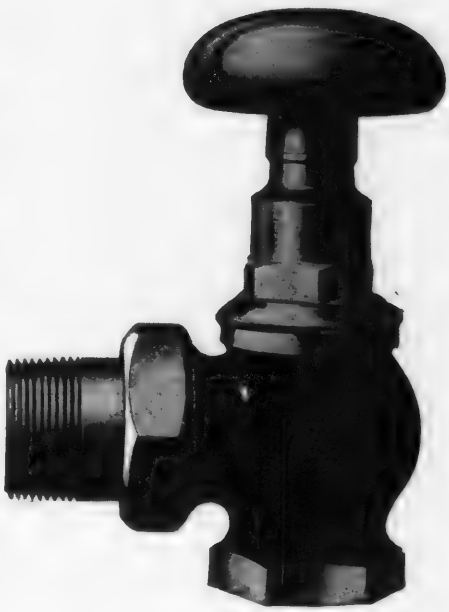

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CANADIAN DETROIT LUBRICATOR COMPANY, LTD. WALKERVILLE, ONTARIO.

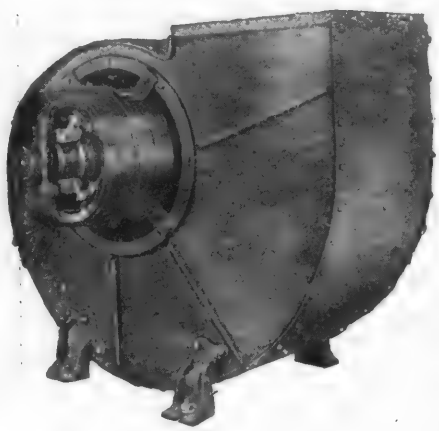
LARGEST MANUFACTURERS OF RADIATOR VALVES IN THE WORLD

is being pushed in Wood Street by the Mahoning and Shenango Railway & Light Company, which bought the old heating system last spring. The new main is 20 in. in diameter.

Newcastle, Ind.—The Interstate Public Service company was given permission to charge 25 cents per square foot of radiation for hot water heat for the coming season. The increase is granted for one year only the permanent rate being twenty cents. At a hearing before the State Public Service Commission, it was stated that the patrons are willing to pay the increased price if they can be assured of adequate service. The company is operating the hot water heating plant in connection with its electric heating plant and the franchise provides that both services must be furnished.

La Porte, Ind.—A possible compromise between the city officials and the La Porte Gas and Electric Company has been worked out, subject to confirmation. The original proposal of the company was to raise its heating rates from 17 cents to 25 cents per square foot of radiation per season. The compromise figure is 20 cents.

Portland, Ore.—Increased cost of fuel has prompted the Northwestern Electric Company to seek permission to advance its rates approximately 20% for steam heating service in the business district. At present



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fuel oil is used to produce steam for the auxiliary electric generating station in the Pittock Block and since the cost of oil has gone so high, Manager W. E. Coman says the increased rates are imperative.

Des Moines, Ia.—Attorney-General Havner has started an investigation of the special election of March 26, 1917, at which a heating franchise was awarded to the Des Moines Electric Company. All the registration books, ballot sacks and poll books connected with the election will be examined. A former grand jury made an investigation of the election but no further action was taken.

Bellefonte, Pa.—Residents of Bellefonte who have been using central station heat are considering the advisability of installing individual heating plants in their homes, owing to the uncertainty as to whether the central heating plant will be operated this winter. Ex-Judge Ellis L. Orvis, who is now in control of the plant, has stated that the operation of the plant depends on the coal situation. If it should be placed in operation a 10% raise will be made over the rates charged by the old company shortly before the citizens took charge.

Spencer, Ia.—Work is proceeding rapidly on the new central heating system in Spencer. Tyler underground conduits are being used.

Springfield, Ill.—In the matter of the application of the Springfield Gas & Electric Company for the revision of rate schedules, rules and regulations pertaining to raising the rates for hot water and steam heating service in Springfield, which is now pending before the State Public Utilities Commission, the city council of Springfield adopted a resolution directing the city attorney to intervene on behalf of the city.

Logansport, Ind.—It is announced that the public service commission has granted the request of the Logansport Heating Company to raise its rates 25%. The local management explains that the raise means 4 cents more per square foot of radiation for hot water heat, this increase making the total rate 21¼ cents.

Sioux City, Ia.—After submitting a petition to the city council for an advance in its heat rates, E. L. Kirk, general manager of the Sioux City Service Company, has asked the city council to withhold action on the proposed amendment to the city ordinance on the ground that there is hope that the government will regulate the price of coal so that the company may at least operate at the same expense as last year. When the company first proposed the increase protests from a large delegation of consumers were made and the opinion was expressed that the increase in the cost of

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the "SYLPHON" is the Recognized Standard.

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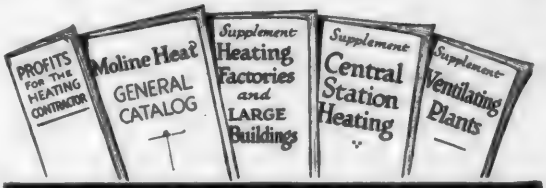
coal, should not necessitate an advance, as a large part of the heat furnished by the service company comes from the steam used and exhausted at the company's power plant. The present ordinance provides for a rate of from 50 to 75 cents for every 1,000 lbs. of steam condensed.

Goshen, Ind.—On recommendation of the superintendent of the municipal water and light plants, plans for the construction of a municipal central station system have been deferred on account of the scarcity and high prices of materials. The city council had appropriated $2,500 to pay for heating the court house and jail with steam from the proposed city station.

Indianapolis, Ind.—Among the companies which have filed petitions with the Indiana Public Service Commission for increases in their heating rates are the Merchants Heat & Light Co., Indianapolis; Indianapolis Light & Heat Co., Indianapolis; Frankfort Heating Co., Logansport Heat & Power Co., Noblesville Heat, Light & Power Co., Indiana Railways & Light Co., Kokomo; Boonville Electric Light & Power Co., Citizens' Mutual Heating Co., Terre Haute; Central Indiana Lighting Co., Bloomington; La Porte Heating Co., and the Interstate Public Service Co., operating at Newcastle, Lebanon, Fowler and Bedford. The public service commission indi-



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This is the sort of service that gives real satisfaction and builds business for the steam-fitter—and the Johns-Manville Radiator Traps are largely responsible. Just 3 parts—body, ball and connecting union—the simplest trap on the market. It will pay you to get the details.

H. W. JOHNS-MANVILLE CO.
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10 Factories—Branches in 55 Large Cities

cated that it would not permit any actual changes in the existing rates but that if the various petitioning companies could show just cause the commission would permit a surcharge sufficient to offset the increased cost of operation.

Most of the petitioning companies gave the high price of coal as the principal reason for the present unsatisfactory conditions.

The Crawfordsville Heating Company asked for permission to make a surcharge on its steam heating rates which would raise them from 22 cents to 30 cents per square foot of radiation.

The Frankfort Heating Company asked for permission to make a surcharge of 14.6% on the ground that there had been an 18% advance in the total cost of operation. Testimony showed that there had been $6,000 of increased cost for coal during the last season. No one from Frankfort appeared to protest.

The Logansport Heat and Power Company asked for a surcharge of 32.3%, as the plant was operated at a loss last season, and there has been a big advance in the price of coal. There were no protestants from Logansport.

Henry Meyer, of the Citizens' Mutual Heating Company, of Terre Haute, gave figures to show that the company should be allowed to make a surcharge of 9 cents a square foot of radiation. He said that last year the company was able to buy coal at $1.25 a ton delivered, but on July 14 of this year the contract called for the payment of $2.50 a ton at the mine for screenings or run of mine, which would make the cost about $2.85 a ton delivered into the plant. Testimony was given to show that other material and labor were greatly increased in cost.

Mr. Wilson, of the Interstate Public Service Company, asked the commission to raise the rate for heating service at Bedford from 15 cents a square foot of radiation to 25 cents. After Chairman Lewis informed Mr. Wilson that the commission was not prepared to take up the fixing of permanent rates without first making a valuation of the plant, the petition was changed so as to make the proposed raise a temporary surcharge. Mr. Wilson said the heating service had been supplied at a loss at Bedford for two years, and the company would have to expend $8,000 on urgently needed improvements. W. E. Clark, city attorney of Bedford, and representatives of the Chamber of Commerce of Bedford and consumers, said they did not question the fact that the cost of operation had greatly increased, but they said they were opposed to a raise in the rates until the company

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The Dodge Bros. (Motor Cars) Office and Plant are almost exclusively equipped with Sirocco Products.

Their fine office building, here shown, is served by the Sirocco Washed Air System Their Dining Room, Kitchen, Core Shop, Pressed Steel and Gear Shop have the healthful influence of a constant supply of fresh, properly tempered air. These departments, too, are served by Sirocco Apparatus.

Book No. 2709 illustrates many plants in which "Sirocco" Systems are used. May we send it to you?

AMERICAN BLOWER CO.
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Our Engineering Department will gladly assist in solving your air handling problems

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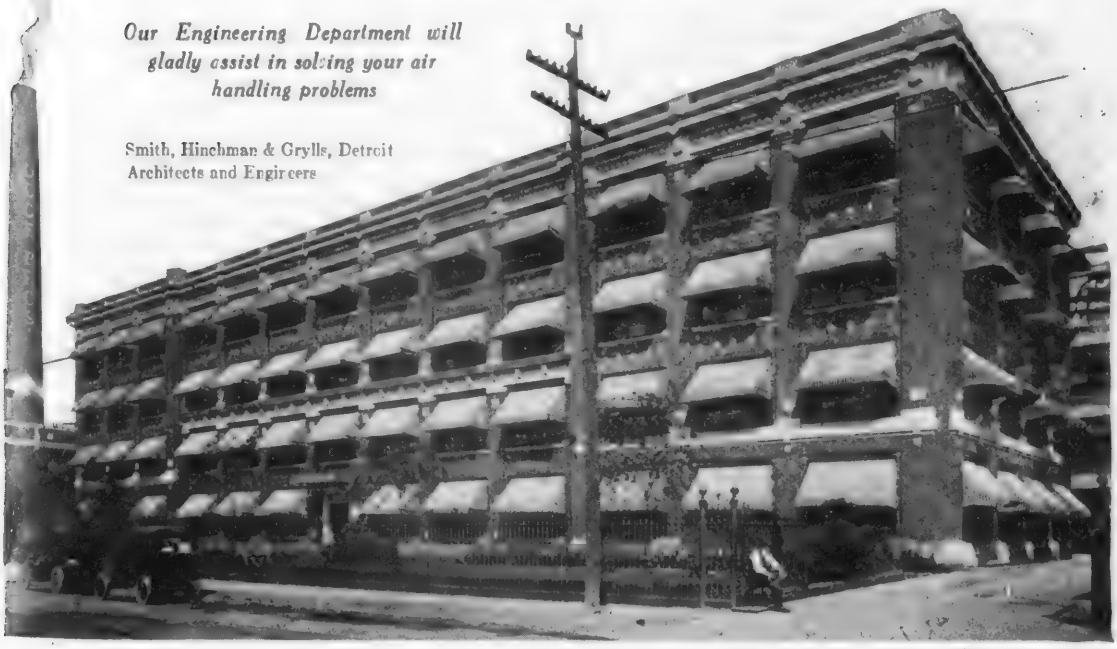

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had improved its service so that it would be efficient. The Bedford plant also supplies electric service and gas.

The Interstate Public Service Company, which supplies electric, ice and heating service at Lebanon, asked for an increase in the heating rates at Lebanon from 17 cents a square foot of radiation to 25 cents. It was urged that coal had increased in price from $1.70 a ton, paid last season, to $2.37, which must be paid the coming season, and that considerable money will have to be spent on repairs to mains. William J. Wood, city attorney of Lebanon, and also representing the Lebanon Business Men's Association, tried, through questions put to the company's officials, to show that the amount of increase requested was too high.

P. H. Palmer, general superintendent of the Indiana Railways & Light Company, which supplies heat service at Kokomo, asked for a temporary surcharge of 30%. He said that the steam heating department had never been a profit to the company, and there has been a tremendous increase in operating expenses. Coal was bought last season at $1.82 a ton, he said, and for the next season it is estimated the cost will be $2.75 a ton. Mr. Palmer said his company had recently bought a coal mine near Oakland City for a price exceeding the actual value of the mine, due to the ab-

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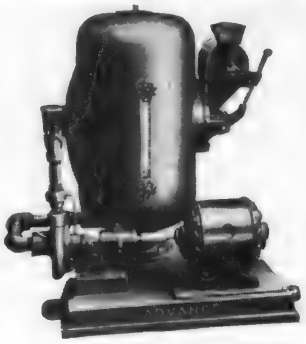
CONDENSATION PUMPS
For Low Pressure and Vapor Heating Systems



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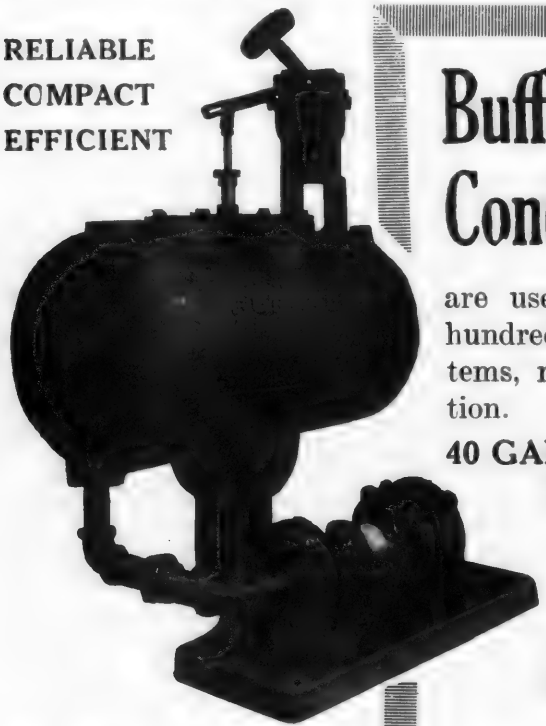

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are used to handle returns to boilers in hundreds of low pressure heating systems, materially reducing fuel consumption.

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BRASS FITTED PUMP

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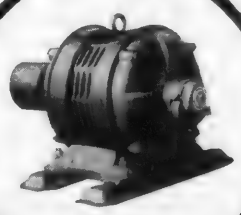

normal coal prices now prevailing, but he did not figure that the ownership of the mine would greatly improve the coal situation for the company next season.

In denying the petition of the Frankfort Heating Company the order handed down by the commission says: "It was right and proper in fixing a permanent rate, that the commission should provide a 2% return on accepted valuation," but that conditions have changed that it is not deemed advisable to grant an increase of rates which would "be simply underwriting a 7 or 8% dividend."

The commission denied the petition of the Boonville Electric Company for a surcharge of 30% as it was found the present rates are sufficient to yield a 5% dividend.

Contracts Awarded.

Derheimer Bros., Fort Wayne, Ind., heating and ventilating new $150,000 Y. M. C. A. building in Fort Wayne for $20,000.

Chas. McGovern & Sons, Sioux Falls, S. D., heating, ventilating and plumbing new City Hall, for $18,456. Other bids were, Guy W. Barrett, heating and ventilating $15,099, plumbing $4,006; Sanitary Heating & Plumbing Co., heating and ventilating $18,153.27, plumbing $5,098 (if fans, motors and Vento are omitted deduct $1,865); Jas. Ferris & Son, heating and ventilating $18,500, plumbing $5,500 (if fans, motors and Vento are omitted deduct $2,000).

Oller Heating Co., McAlester, .Okla., heating and plumbing Agricultural and Normal University at Langston for $7,005.

L. H. Prentice Co., Chicago, Ill., heating Christopher Columbus Settlement House at Greenview Avenue and Altgeld Street, Chicago.

Orth Plumbing Co., Lafayette, Ind., heating, ventilating and plumbing for Oakland Township school, for $15,500.

Buhl Plumbing & Heating Co., Buhl, Minn., heating, ventilating and plumbing new high school building in Buhl, for $11,001.

Healy Heating & Plumbing Co., St. Paul, Minn., heating and plumbing new Washington School at Marshalltown, Ia., for $20,595.

New Incorporations.

East Fulton Hardware, Heating and Plumbing Co., Grand Rapids, Mich., capital $20,000. Stockholders: Harry Vander Veen, Jennie Gouan, Cornelius Van Houten and others.

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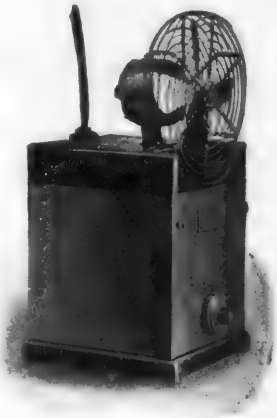

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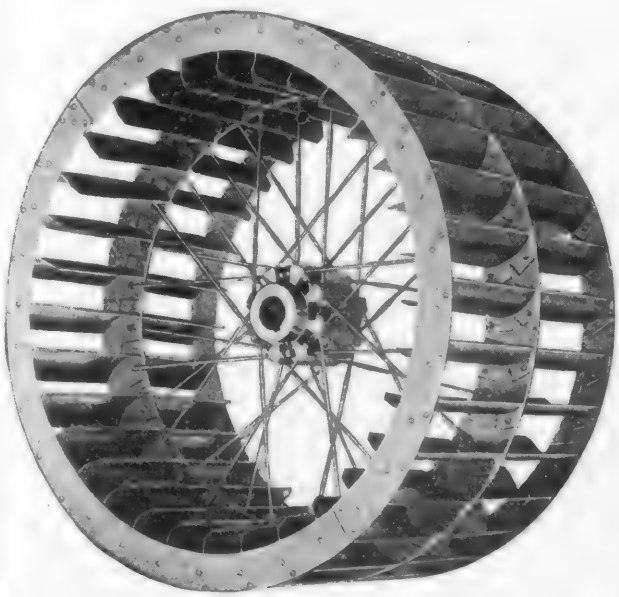

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BAYLEY MANUFACTURING CO., Milwaukee, Wis.

Harry Taub, Inc., Plainfield, N. J., capital $5,000, to conduct a heating and plumbing business. Incorporators: H. Taub, J. Taub, and J. P. Mattley, all of Plainfield.

Philo Light, Heat & Power Co., Philo, Ill., capital $5,000. Incorporators: John B. Carson, David E. Godfrey and O. B. Carson.

Eggleston Plumbing & Heating Co., Boston, Mass., capital $10,000. Incorporators: Timothy F. Hurley, John L. Mahoney and Mary J. Hurley, all of Boston.

Purcell-Cox Corporation, Hartford, Conn., capital $50,000, to deal in heating and plumbing supplies. Incorporators: John L. Purcell, Hartford; Frank Cox, Springfield, Mass.; M. W. Purcell, Hartford; and D. A. Cox, Springfield, Mass.

Window Ventilator Company of America, Chicago, Ill., capital $75,000, to manufacture ventilating systems. Incorporators: E. W. Clark, H. C. Peterson and Charles Martin.

Deal Plumbing & Heating Co., Amesbury, Mass., capital $7,000. Treasurer and clerk, Carrie E. Deal, Newburyport.

New Firms and Business Changes.

Indiana Engineering Co., Inc., Indianapolis, Ind., has taken over the Cameron-Wainscott Plumbing and Heating Company, at 3016 North Illinois, Illinois Street. The company will conduct a heating, plumbing and power plant contracting business. The officers are: President and chief engineer, Omar B. Morgan; secretary and treasurer, G. B. Morgan; assistant engineer, M. E. Smith.

Financial Troubles.

Monarch Ventilator Co., New York, has had a petition in bankruptcy filed against it by creditors. The liabilities of the company are given at $59,000 and the assets at $12,000.

Business Chances.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until October 15, 1917, for the construction of the U. S. Post Office at Waynesboro, Va.

Until October 23, 1917, for the construction of the U. S. Post Office at Ansalusia, Ala.

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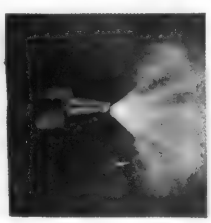

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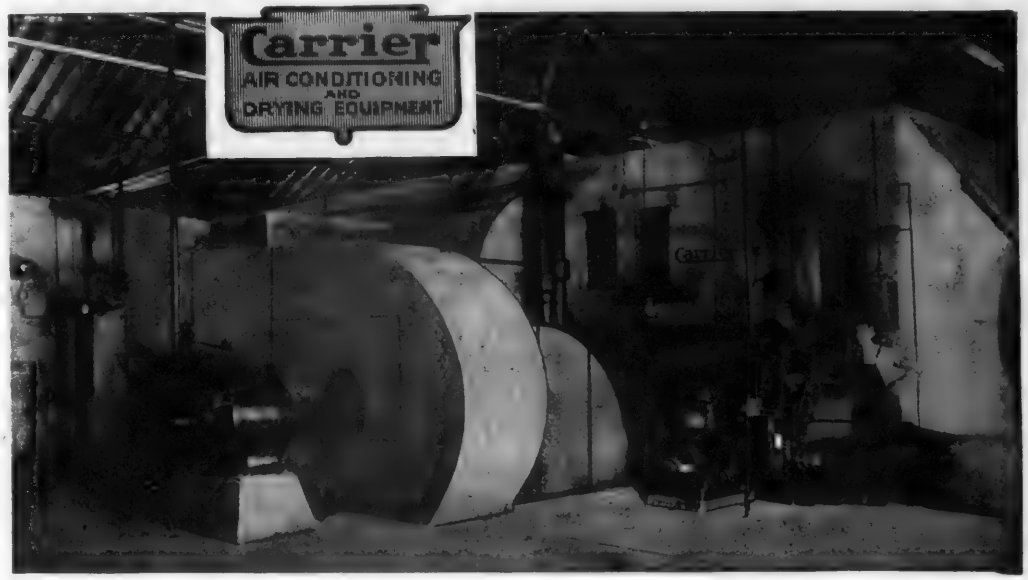

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Such well known names as Thomas A. Edison, Inc., Bethlehem Steel Co., General Electric Co., The Vitagraph Co., Proctor & Gamble, J. P. Morgan & Co., American Can Co., Curtis Publishing Co.—all leaders in their respective lines—are on the list of those hundreds of representative firms who have endorsed the Carrier System by using it.

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Until October 25, 1917, for the construction complete of the U. S. Post Office at Mount Carmel, Ill.

Until October 29, 1917, for the construction of the U. S. Post Office at Waterloo, N. Y.

Louisville, Ky.—The Karlsbad Hotel Company, at Dawson Springs, Ky., is planning to build a $2,500,000 hotel at Dawson Springs, to be used all the year as a health resort. The hotel company has been incorporated with a capital stock of $6,000,000. The building contemplated is an eight-story structure, with 1,049 rooms, all to have running water, baths, etc. The president and treasurer of the company is T. R. Troendel and the managing director, L. M. Boomer, of New York.

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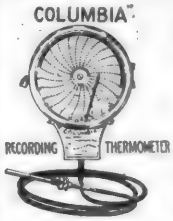

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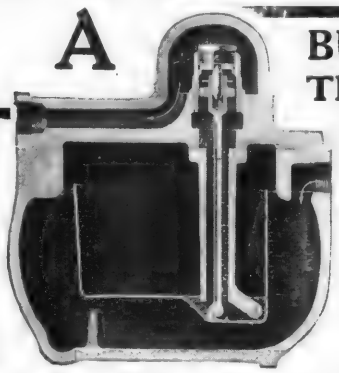

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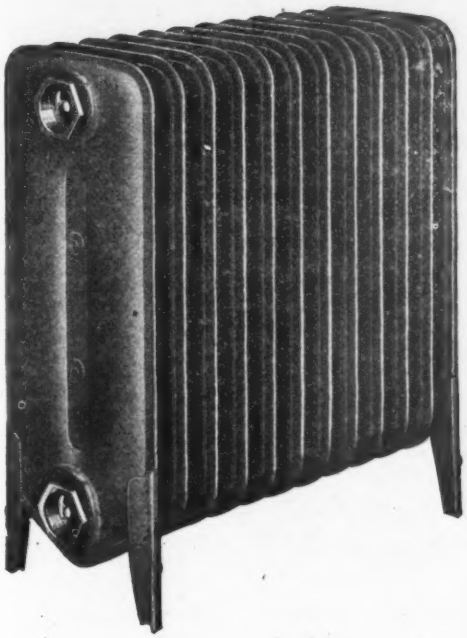

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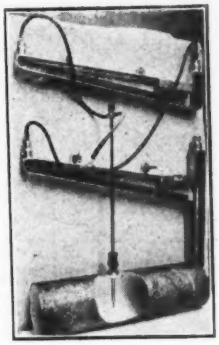

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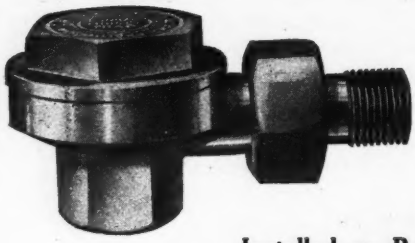

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